

STRUCTURE OF THE MICROCARD (BASIC INSTRUCTIONS)

A02 = How to use the microcard		1	2	3		4
A01 = Structure of microcard				SIS		
B01 = Trouble-shooting chart	-A-	-***X*	X*XXX	XXXXX	XXXXX	*XXXX X
	-B-	-*XXXX	XXXXX	XXXXX	XXXXX	XXXXX XXX
	-C-	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX XXX
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N01 = Service Information	-N-	-*XXXX	XXXXX	XXXXX	XXX	XX XX*
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- Index
- N28 = Table of contents and publication information
- 1 = Special features
  - 2 = Safety and precautionary measures
  - 3 = Test equipment and tools
  - 4 = Installation position of components

- a. Read from left to right.
- b. Title of micropicture (appears on each coordinate).

E16	Product/component/test step	
	Coordinate	

c. Limits of section

<u>==&gt;</u>	<u>&lt;==&gt;</u>	<u>&lt;==</u>	<u>=&gt; &lt;=</u>
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A01			=> <=

HOW TO USE THE MICROCARD

Trouble-shooting instructions for

System: ABS 2 B

Descriptions, photographs, terminal designations and special features refer to the vehicle:

OPEL Omega

with 1.8 l / 4-cylinder engine 10.86 ->

These basic instructions are detailed trouble-shooting instructions. They must not be used as vehicle-specific instructions. Attention! Descriptions and photographs may deviate from those in the vehicle-specific brief instructions.

Binding set values, terminal assignments and special features must be taken only from the vehicle-specific brief instructions. For brief instructions, see table-of-contents microcard KFZ-00..

A02		=> <=
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## SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following model:

\* Opel Omega A as of 10.1986->

ABS with 4 wheel-speed sensors and 3 hydraulic channels.

Application of a 4-channel hydraulic modulator, of which only 3 channels are occupied. The 4th channel is blank and in the form of a dummy solenoid-operated valve.

Test using the ABS2 LED tester.

## SAFETY AND PRECAUTIONARY MEASURES

ABS is basically maintenance-free, however, when working on vehicles with an ABS system, the following must be observed:

1. Whenever welding with electric welding equipment, disconnect plug from the electronic controller.
2. Whenever painting the vehicle, the electronic controller may be loaded for a short time to a max. of + 95° C, and for a long time (approx. 2 hours) to a max. + 85° C.
3. After exchange of the hydraulic modulator, the controller, wheel-speed sensor, and of the wiring harness, as well as after work procedures in which contact is made with the ABS assemblies (e.g. accident repair), the complete ABS system must be checked using the tester.  
Make sure that the brake lines, wheel-speed-sensor connections on the controller, and the wheel-speed-sensor plug connections are assigned correctly (see vehicle-specific terminal diagram).
4. After any work is carried out on the brake system, this system must be bled and a high-pressure test conducted.  
All junctions must be tested for leakages.
5. Be sure to properly tighten the battery-cable terminals on the terminal posts of the battery.
6. Do not use a fast charger for starting the engine.
7. Never disconnect the battery from the vehicle electrical system while the engine is running.

SAFETY AND PRECAUTIONARY MEASURES  
(CONTINUED)

8. Disconnect the battery from the vehicle electrical system before fast charging.
9. Make sure that all connectors of the wiring harness are seated properly.
10. Never disconnect or connect the ABS wiring-harness plug of the controller when the ignition is switched on.
11. For safety reasons, the hydraulic modulator must never be repaired, but be exchanged only as a complete unit.

Excepted from this are the motor relay and the valve relay.

Both relays may be exchanged.

Apart from the brake-line connections, no screws at the hydraulic modulator may be loosened.

Once they are loosened, it is impossible to make the brake circuits leak-free ever again!

D a n g e r   o f   f a t a l   a c c i d e n t !

Caution when handling brake fluid!

- a) Pour brake fluid only into containers from which it would be impossible to mistakenly consume the fluid internally.

(D a n g e r !   P o i s o n !)

SAFETY AND PRECAUTIONARY MEASURES  
(CONTINUED)

- b) Even the slightest trace of mineral oil leads to failure of the brake system. Special care must be taken with colorless or yellow-tinted brake fluid, since the danger of a mix-up is greatest with such fluid. If mineral oil is found in the brake system or there is a suspicion of mineral oil being in the brake system, the complete brake system must be thoroughly flushed out with brake fluid. In addition to this, the master cylinder must be replaced.
- c) Do not allow brake fluid to come into contact with the paintwork of the vehicle, since the fluid attacks the paint.
- d) Brake fluid is exceedingly hygroscopic; i. e. it absorbs moisture from the air, thus reducing its boiling point. For this reason, brake fluid must be stored only in well-sealed storage containers.

N o t e :

As the operation time progresses, the boiling point of the brake fluid drops owing to the brake fluid permanently absorbing moisture from the atmosphere. If the brakes are subjected to very severe loading, this can, therefore, lead to vapor-bubble formation in the brake system.

Therefore, the brake fluid must be replaced on an annual basis, preferably in spring.

TEST EQUIPMENT AND TOOLS

Designation	Code	Part number
ABS2 LED tester	KDAS 0003	Procure. address: Robert Bosch GmbH KH/VKD 3 Postfach 41 09 60 7500 Karlsruhe 41
Adapter lead (included in scope of delivery of tester)	KDAS 0003/2	
Charging and bleeding device		e.g. ATE Part No. 3.9302-1000.4 1)
Bleeder fitting for connection of charging and bleeding device to fluid reservoir of brake master cylinder		ATE Part No. 3.9302.0702.2 1)
Bleeder hose		ATE Part No. 3.3590.2300.1 1)
Auxiliary hose		ATE Part No. 3.9302.0704.2 1)
Brake-pedal-actuating device		ATE Part No. 3.9312.0100.4 1)

1) = obtainable from: Alfred Teves GmbH,  
Guerickestr. 7  
D-6000 Frankfurt (Main)

Test equipment and tools (continued)

Designation	Code	Part number
Pressure tester Tester for checking low- pressure and high- pressure at hydraulic brake systems		e.g., ATE Part No. 3.9305-0200.4 1)
Flat double-end flare nut wrench, 9 x 11 mm		Hazet Part No. 612 2)
Container, approx. 1l for catching the brake fluid		
Brake fluid Use only DOT 4 or brake fluid from the vehicle manu- facturer.		
Electrics tester or multimeter for trouble- shooting	ETE 014.00	0 684 101 400  commercially available

Aids!  
Use only original brake lines from the vehicle manu-  
facturer!

Grease for wheel-speed sensor	Molykote Longterm 2
Protective caps for brake lines	1 900 508 002 (100 pieces)
Protective caps for brake-line connections at hydraulic modulator	1 900 508 004 (100 pieces)

1) obtainable from: Alfred Teves GmbH Guerickestr. 7  
D-6000 Frankfurt (Main)

2) obtainable from: Hazet Co, D-5630 Remscheid



For production reasons:  
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coordinate.

## HOW TO USE THE ABS 2 LED TESTER

### 1. General

The BOSCH ABS 2 LED TESTER checks the ABS components in passenger cars with hydraulic brake system.

Following BOSCH ABS systems can be checked:

- \* All ABS 2 versions (presently ABS 2, ABS 2B)
- \* ABS 2B part of the electronic traction control system (ASR)

The tester tests the peripheral system components in 6 program steps:

- \* Hydraulic modulator
- \* Motor relay
- \* Valve relay
- \* Wheel-speed sensors
- \* Warning lamp
- \* Acceleration sensor
- \* Wiring harness
- \* Cable connections
- \* Ground cables
- \* Stop-lamp-switch signal
- \* Alternator signal

The ABS controller is not tested.

The self-diagnosis facility in the ABS controller means that an additional test of the controller with the tester is not necessary.

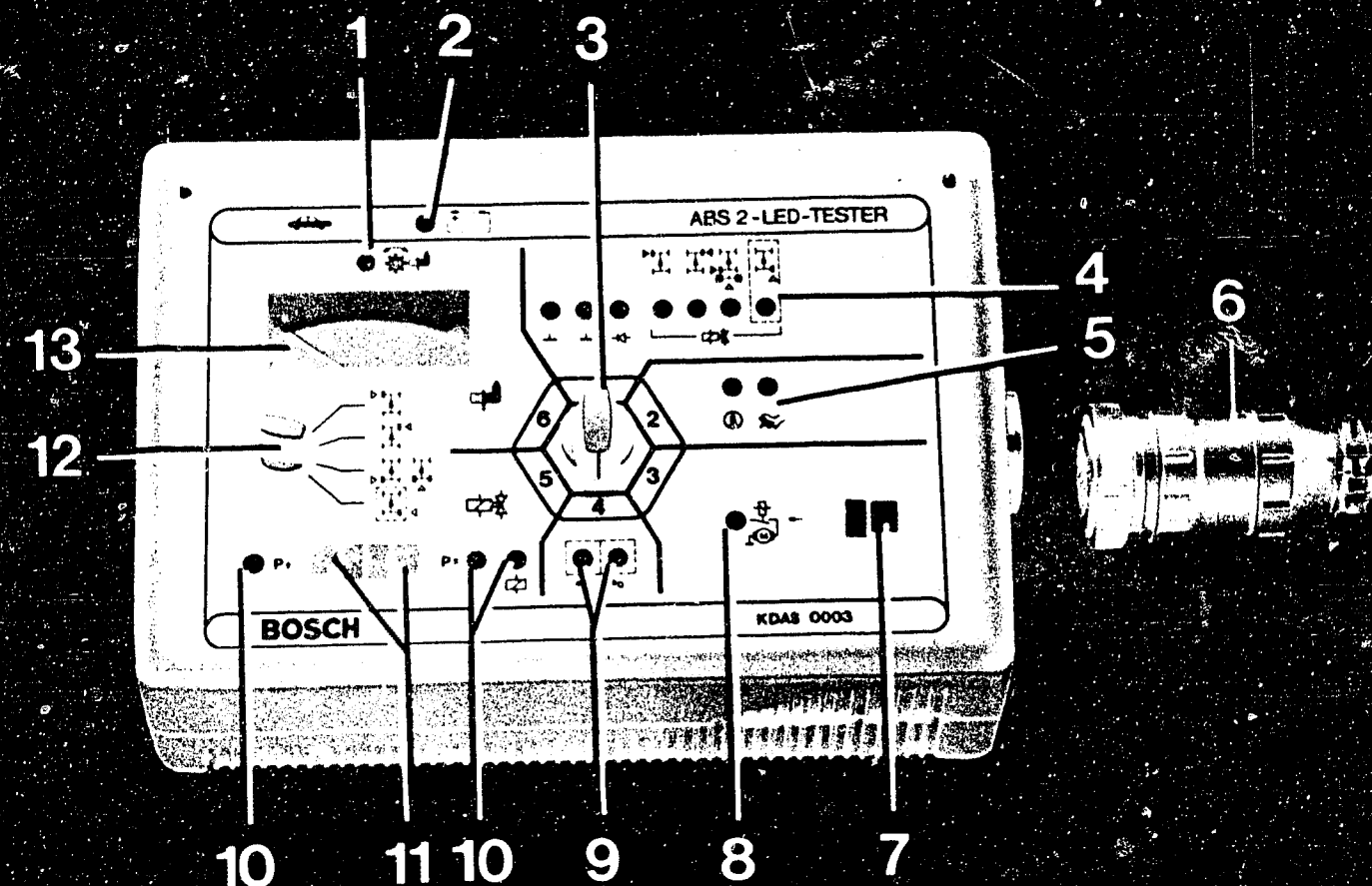
A brake dynamometer is not required for testing the ABS.

If a brake dynamometer is used, there is a danger of the vehicle jumping out of the rollers!

All responsibility for using a brake dynamometer lies with the test personnel.

### 2. Tester setup

Faults are indicated via light-emitting diodes (LEDs) with the exception of the wheel-speed-sensor signals which must be read off from the indicator instrument.



265/241

- 1 = 1 LED indicator for wheel speed in program-selector switch position 6
- 2 = 1 LED indicator for battery voltage
- 3 = Program-selector switch
- 4 = 7 LED indicators for program-selector switch position 1
- 5 = 2 LED indicators for program-selector switch position 2
- 6 = ABS adapter lead for connection to ABS wiring harness in vehicle
- 7 = Push-button for motor-relay activation in program-selector switch position 3
- 8 = 1 LED indicator for program-selector switch position 3
- 9 = 2 LED indicators for program-selector switch position 4
- 10 = 3 LED indicators for program-selector switch position 5
- 11 = 2 push-buttons for triggering the solenoid-operated-valve functions.  
Pressure holding and pressure reduction in program-selector switch position 5
- 12 = Rotary switch for selection of individual wheels.  
Operational in program-selector switch positions 5 and 6
- 13 = Indicator instrument for program-selector switch position 6

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

- \* ABS warning lamp:  
in the instrument panel in the indicator-lamp strip, 3rd indicator lamp from the left.
- \* Wheel-speed sensors, front axle:  
one on each side in the steering knuckles.
- \* Wheel-speed sensor, rear axle:  
one on each side of the differential.
- \* Hydraulic modulator:  
in the engine compartment at the front on the left.
- \* Controller:  
in the footwell on the driver's side on the left-hand outer side.
- \* Overvoltage-protection relay:  
in the engine compartment on the left near to the firewall in the relay plate.
- \* Ground terminal:  
near to the headlamp

For production reasons:  
continued on the following  
coordinate.

## OPERATION AND TESTING OF THE ABS WARNING LAMP

A vehicle equipped with ABS comes into the workshop with one of the following customer complaints:

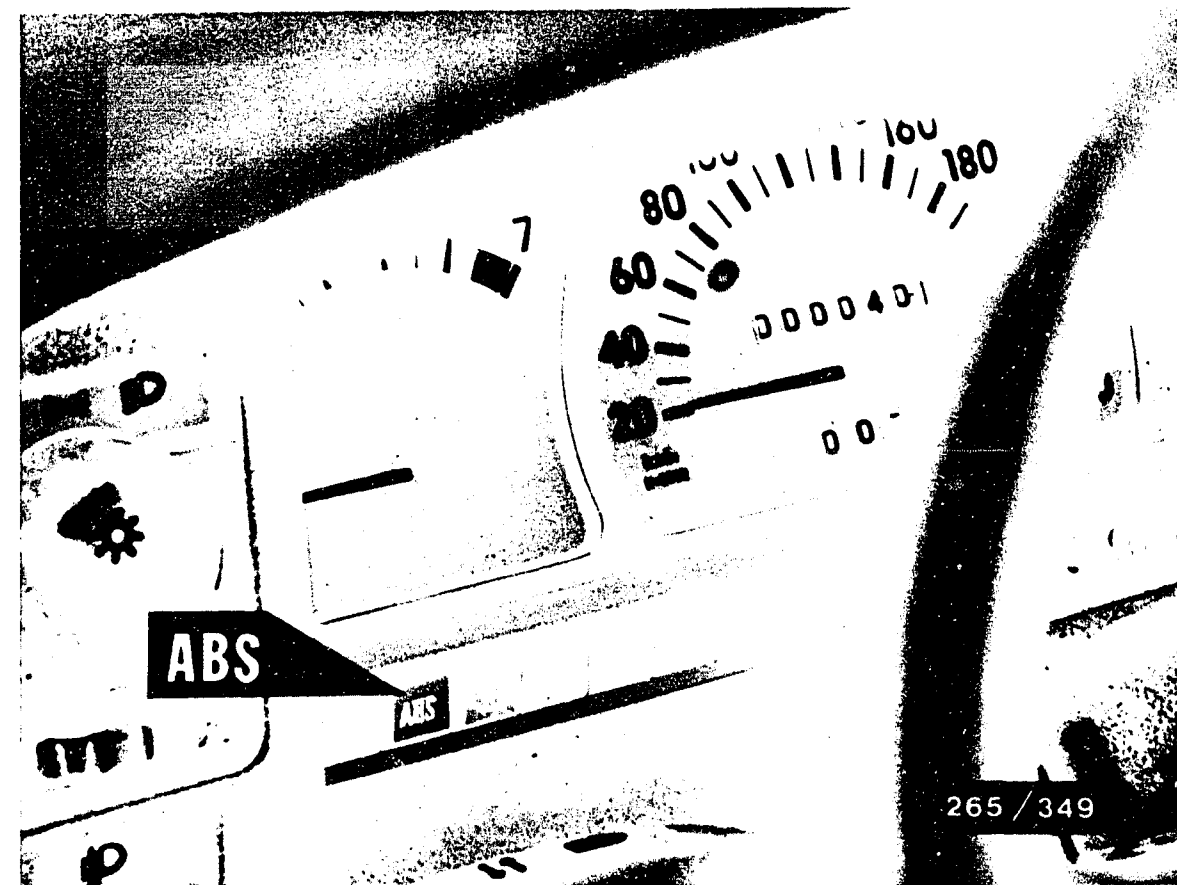
- \* Warning lamp does not light up after switching on ignition.
- \* Warning lamp does not go out after reaching idle speed.
- \* Warning lamp lights up again while driving or lights up occasionally.

Make sure of the circumstances before checking the complete ABS system with the ABS tester.

For reasons of safety, testing of the ABS is permitted only with the ABS tester.

When connecting the ABS tester, just as when disconnecting and connecting the controller, the ignition must always be switched off.

The following gives information about the functioning and malfunctioning of the ABS warning lamp.



ABS = ABS warning lamp in instrument panel

### ABS warning lamp

When the ignition is switched on, the warning lamp, marked with the letters "ABS", lights up.

When the engine starts and reaches idle speed the ABS warning lamp goes out (terminal 61 of generator supplies voltage to ABS controller). As soon as all 4 wheels of the vehicle exceed a speed of approx. 6 km/h for the first time after starting, the ABS system tests itself automatically (BITE sequence).

This procedure is repeated every time the ignition is switched off and the engine started up again. In addition, the ABS constantly tests itself to a certain extent while the vehicle is travelling.

### Incorrect warning-lamp indications are:

- \* Warning lamp does not light up after switching on ignition.
- \* Warning lamp does not go out after reaching idle speed.
- \* Warning lamp lights up when driving or lights up occasionally.

Lighting-up of the ABS warning lamp indicates to the driver that the ABS is defective.

Nevertheless, braking can still take place with the conventional brake system.

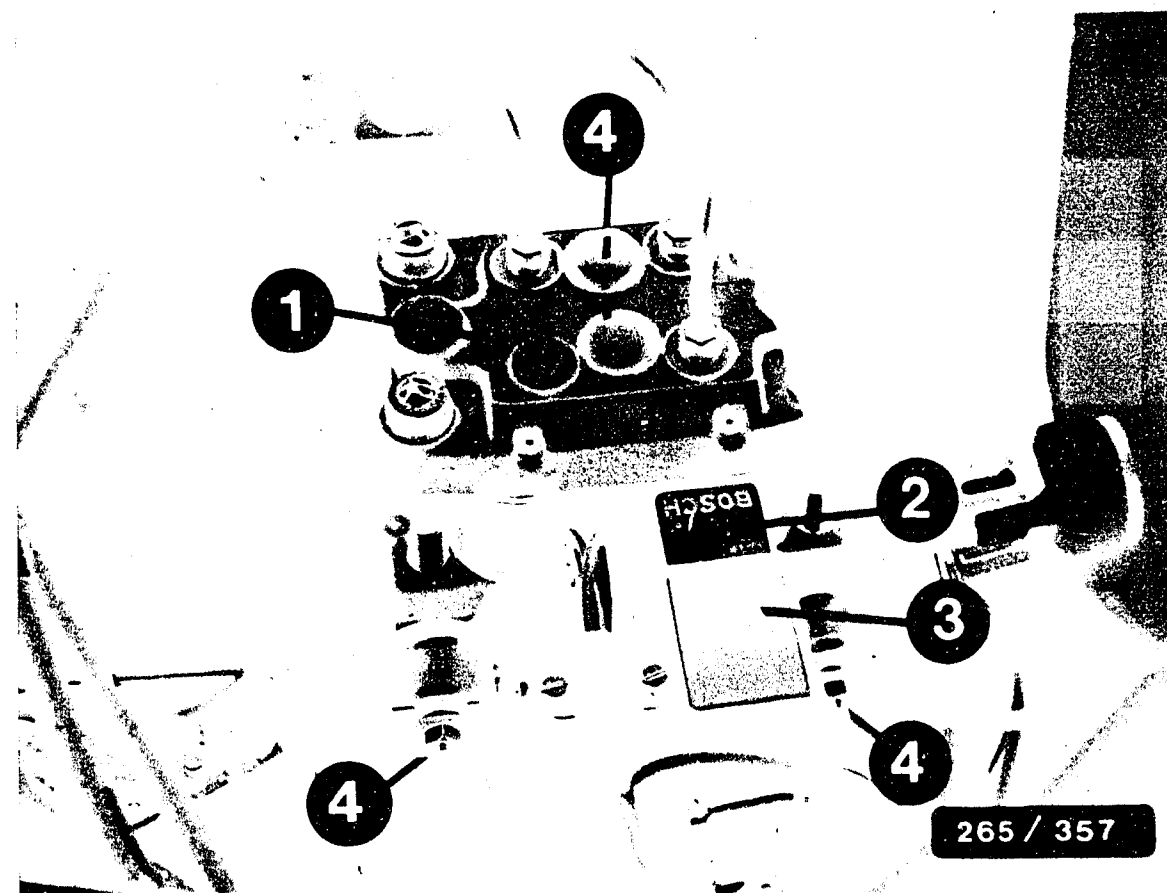
However, it is possible for the wheels to lock.

### General information:

Occasional lighting up of the warning lamp may be brought about through the battery being insufficiently charged.

The lamp lights up only as long as there is under-voltage, e.g. after switching on consuming devices when at idle.

The causes of trouble can be determined with the assistance of the ABS tester.



- 1 = Hydraulic modulator
- 2 = Valve relay
- 3 = Motor relay
- 4 = Fastening nuts

### TEST REQUIREMENTS FOR TESTING WITH ABS 2 LED TESTER

- \* Regulatory tire size fitted?
- \* Check that the ground of the return-supply pump is firmly seated.
- \* Test for firm seating and corrosion of ground of overvoltage-protection relay term. 31.
- \* Check for firm seating of ground strap between engine block and vehicle frame.

- \* Check for leaks in hydraulic connections and sealing points at hydraulic modulator (visual examination).
- \* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on consuming devices) and goes out again by itself, check the battery and power supply (generator, regulator and voltage drops).

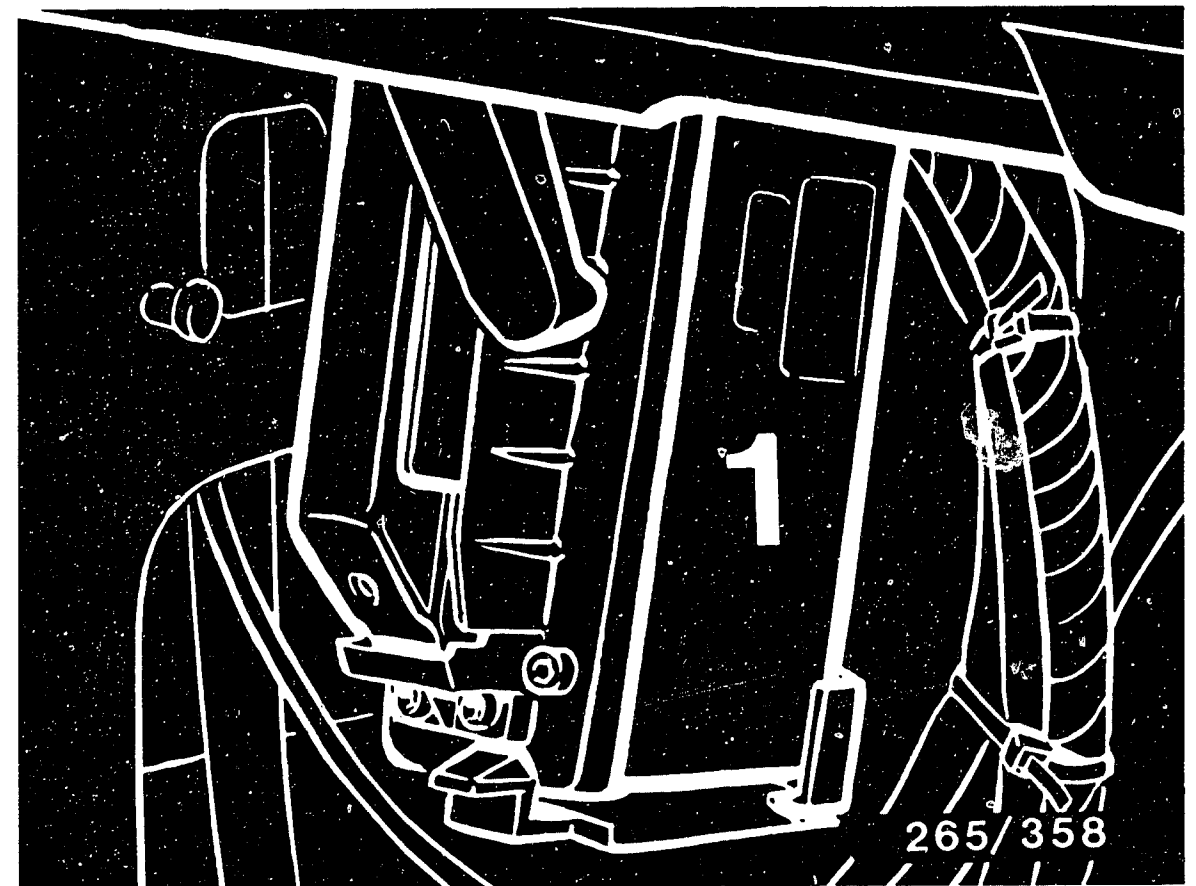
- \* If the ABS warning lamp lights up constantly and does not go out, check the following points:

- Controller plug seated correctly on controller and latched?
- All plug contacts O.K.?
- Spring contacts latched?
- Check installation position of seal ring in controller plug for correct seating: rounded side downwards.
- Check for correct assignment of wheel-speed-sensor leads at controller plug.

#### Wheel-speed sensor:

front left to term.: see brief instructions  
 front right to term.: see brief instructions  
 rear left to term.: see brief instructions  
 rear right to term.: see brief instructions  
 rear axle to term.: see brief instructions

- V-belt snapped? (Generator provides no voltage, charge-indicator lamp and ABS warning lamp light up).



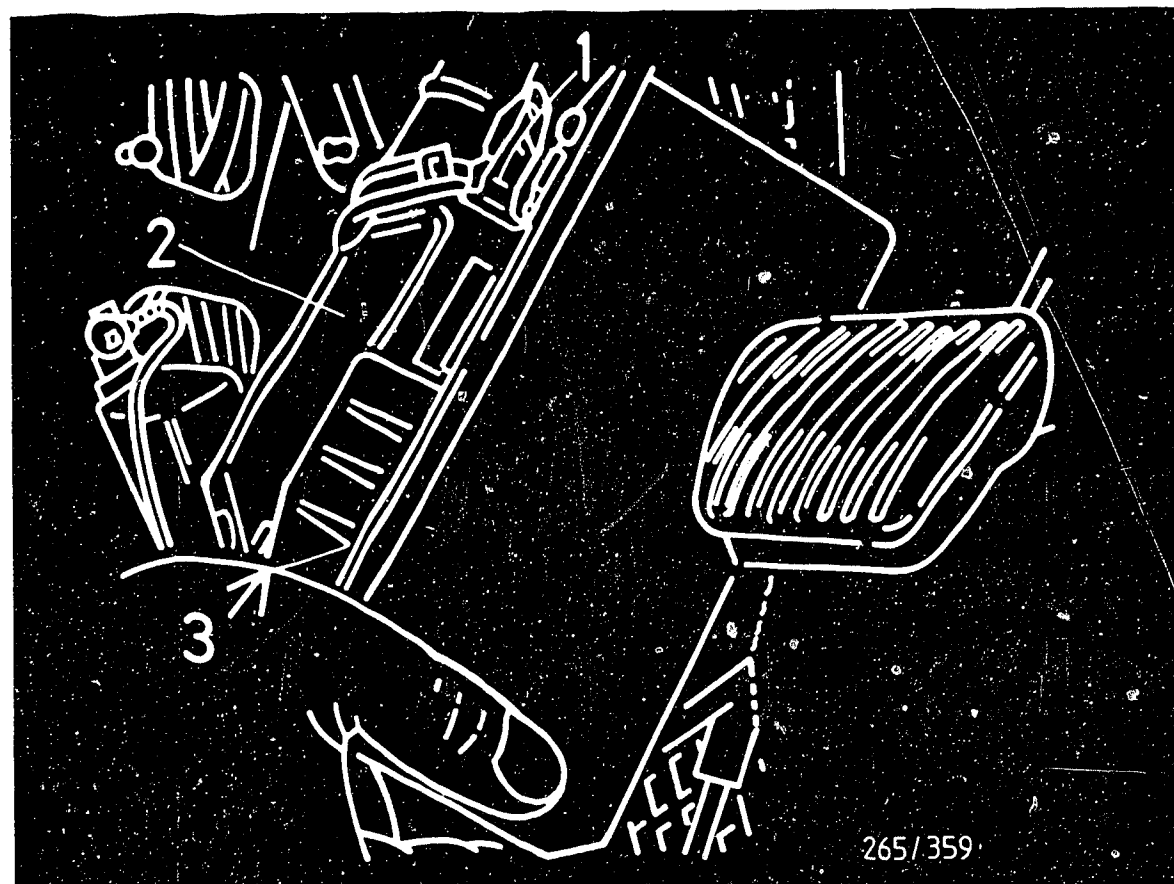
1 = Controller for ABS

- \* Connect LED tester to ABS wiring harness.

#### CAUTION!

Disconnect and connect controller only with ignition switched off.

The controller is installed in the passenger compartment on the left in the footwell.



- 1 = Spring
- 2 = Controller plug (35-pin)
- 3 = Coding unit

Switch off ignition before disconnecting controller plug.

Push back spring, pivot controller plug upwards and disconnect from coding unit.

- \* For checking with tester, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).
- \* One LED (green) indicates whether the voltage is sufficient.

#### Caution!

Do not run with tester connected!

After each repair, repeat the complete test program.

#### General note for trouble-shooting

Check all leads for short circuit to ground and contact with positive leads and watch out for rubbed and pinched locations.

# TEST CHART FOR ABS 2 LED TESTER

TEST STEP 1

( TEST SPECIFICATIONS AND NOTES ON OPERATION )

## Component/Operation

Voltage supply (term. 20 and term. 1)

\* Operation: Position:  
Program switch all  
Push-button -

\* Operation in vehicle:  
Ignition on.

\* Test specification (indication)  
LED 1 (upper illustration) lights  
up continuously in all program-  
selector-switch positions.

## Trouble-shooting:

Switch off ignition!

No reading:

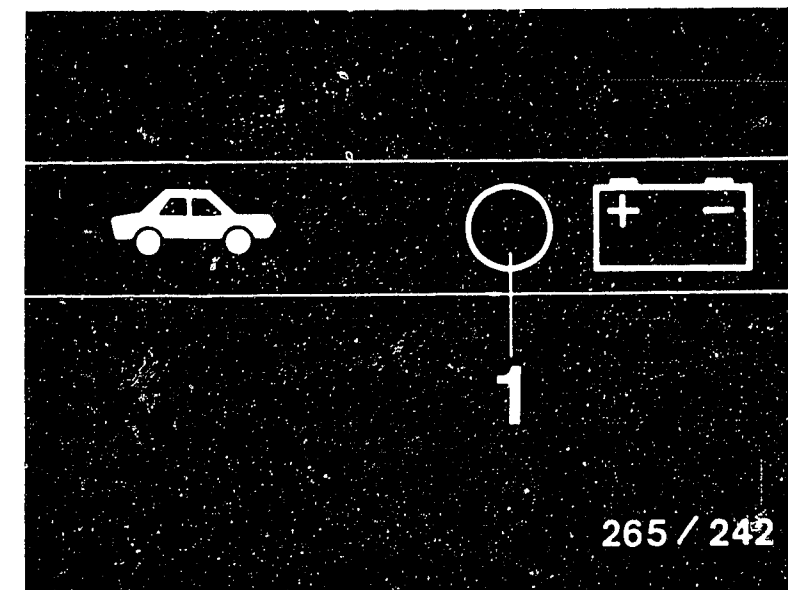
- \* Controller plug not connected properly.
- \* Fuse in overvoltage-protection relay defective.
- \* Overvoltage-protection relay defective: exchange.

Check the following lines:

- \* Positive cable from B+ to overvoltage-protection relay term. 30
- \* Negative lead from over-voltage protection relay term. 31 to ground.
- \* ABS ground terminal must be bare metal and must have no contact resistance.
- \* Positive lead from over-voltage-protection relay term. 30a to controller plug X1/term. 1.

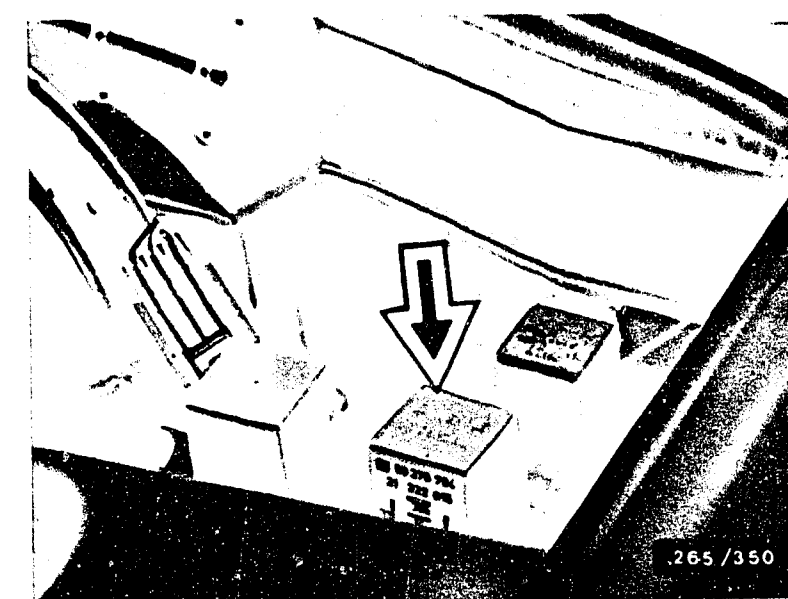
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1 = LED for supply voltage

Arrow = Overvoltage-protection relay





\* Positive lead from overvoltage-protection relay term. 86 to driving switch term. 15.

\* Test for firm seating of ground strap between engine block and vehicle frame.

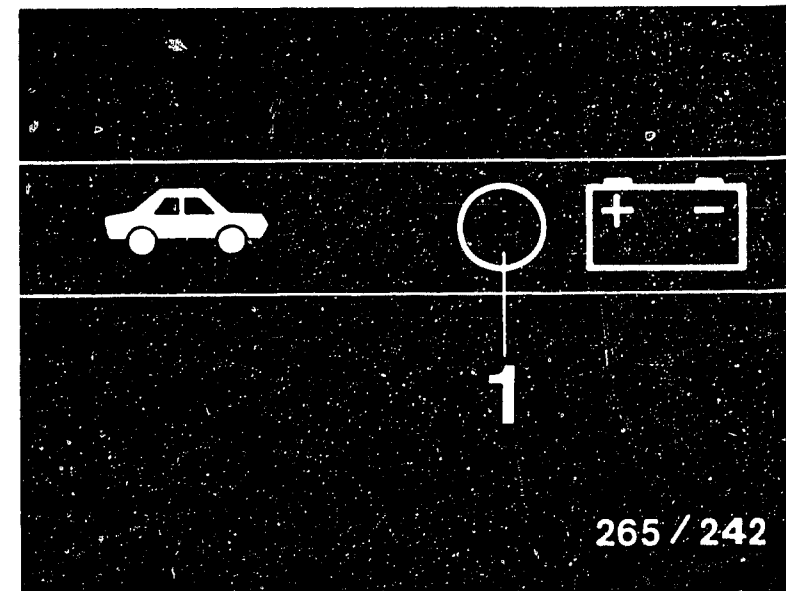
LED 1 (green) lights up occasionally during the test procedure:

\* Interrupt test and eliminate fault.

Causes of fault:

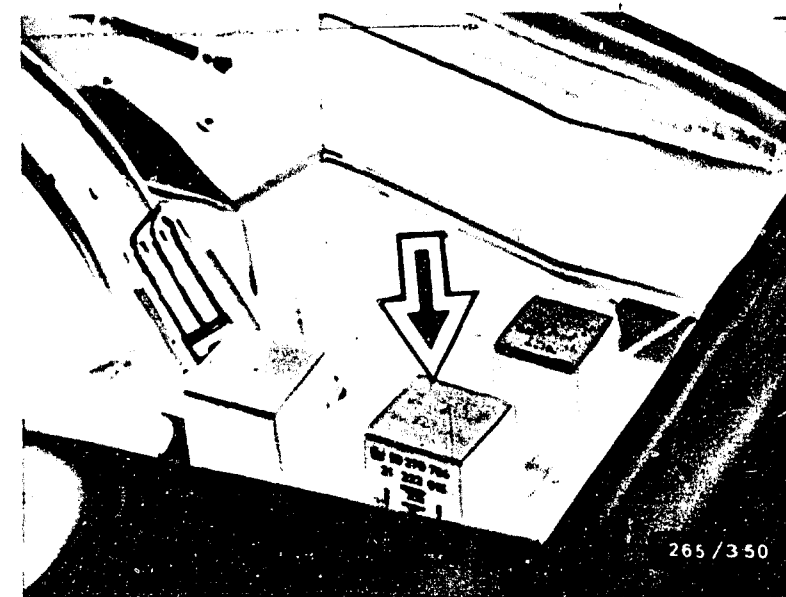
1. Battery insufficiently charged.  
Charge battery or leave engine running.
2. Voltage drops at ABS relay terminal too high, ground terminal must be bare metal.

After eliminating the fault, conduct the complete test program.



1 = LED for supply voltage

Arrow = Overvoltage-protection relay



Component/Operation:

Ground (term. 34, term. 10)  
Diode for warning lamp (term. 29, term. 32)  
Solenoid-valve internal resistances term. 2, term. 35, term. 18.  
Off-position and ground of valve relay.  
ABS warning lamp.

\* Operation:                      Position:  
Program switch                      

1
-

  
Push-button

\* Operation in vehicle:  
Ignition on.

\* Test specification (indication)  
LED 1 up to LED 4.3 light up equally brightly (see upper illustration).

ABS warning lamp in vehicle must light up.

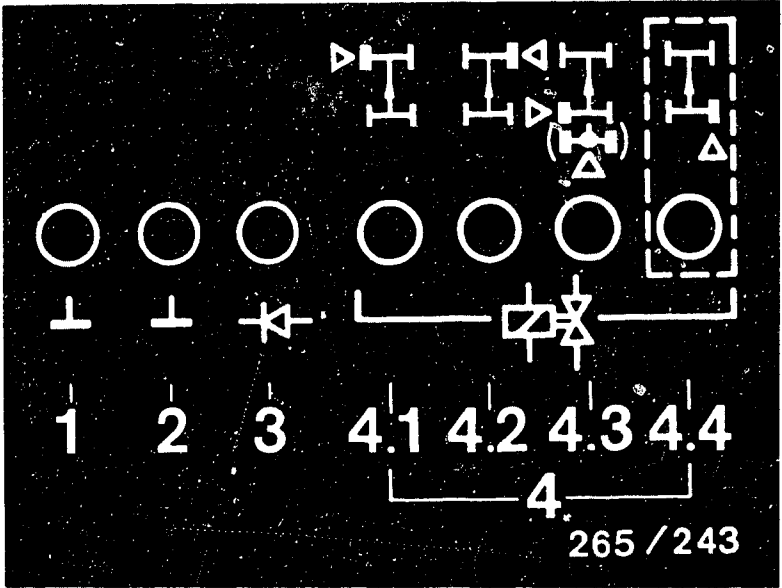
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Trouble-shooting:

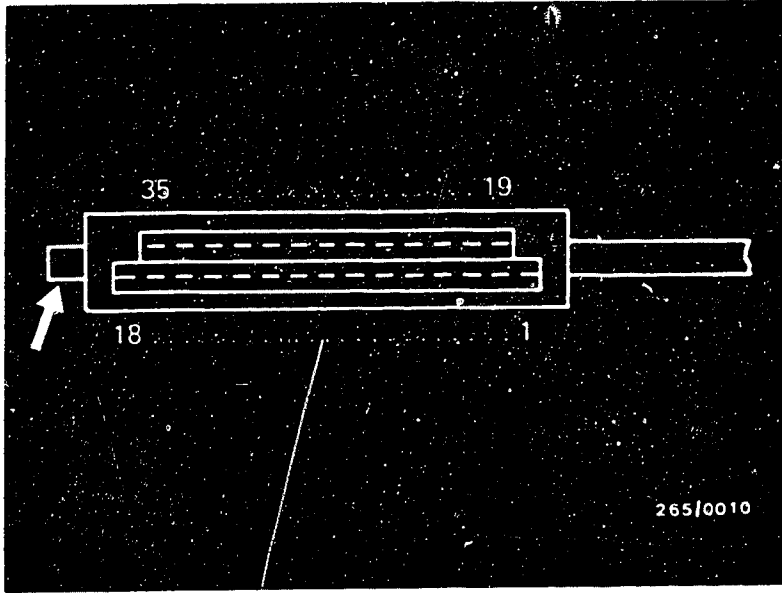
Switch off ignition!

1. LED 1 and / or 2 (upper illustration) do(es) not light up:

- \* Test for firm seating, too high a contact resistance and open circuit in ground terminal to bodywork near to headlamp, and in ground strap between engine block and vehicle frame.
- \* Test for contact resistance and open circuit in lead from controller plug X1/term. 10 to ground terminal.
- \* Test for contact resistance and open circuit in lead from controller plug X1/term. 34 to ground terminal.
- \* Valve relay defective. ATTENTION!  
Use only a relay with correct electrical terminal assignment.



Plan view of controller plug X1 (35-pin) with terminal numbers.  
Arrow = Lug with mechanical encoding



2.LED 3 does not light up:

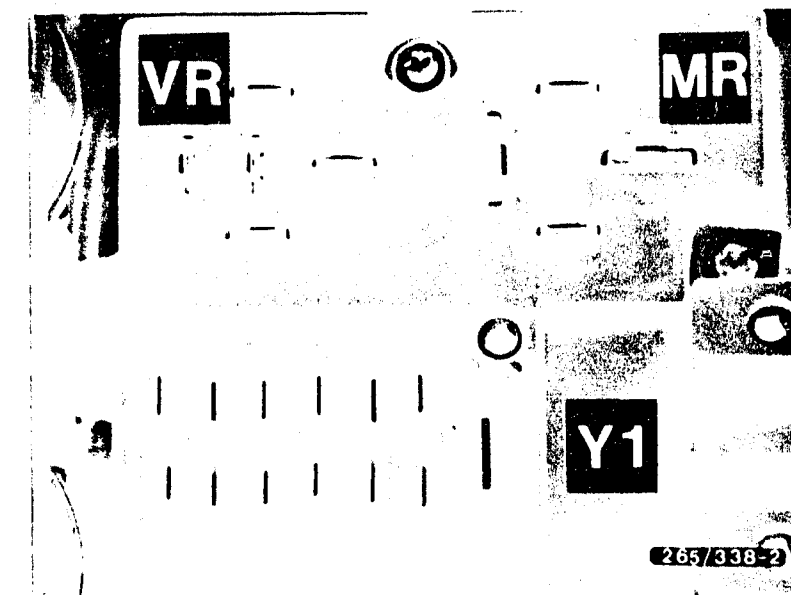
\* Measure diode in forward and reverse directions with ohmmeter directly at hydraulic modulator. Measure between Y1/term.10 and Y1/term. 12. If diode defective, exchange hydraulic modulator.

\* Test for contact resistance and open circuit in ground of valve relay. From plug Y1/term. 8 to ground terminal.

2.One or several LEDs no. 4 do not light up.

\* Measure internal resistance directly at hydraulic modulator.  
Test specifications:  
Valve VL (LED 4.1) between Y1/term. 3 and Y1/term. 12: see brief instructions  
Valve VR (LED 4.2) between Y1/term. 5 and Y1/term. 12: see brief instructions  
Valve H (LED 4.3) between Y1/term. 7 and Y1/term.12 : see brief instructions

\* If test specification not obtained:  
exchange hydraulic modulator.



Pluggable printed-board assembly, hydraulic modulator, position of the terminals:  
VR = Valve relay  
MR = Motor relay  
Y1 = Wiring-harness plug

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\* Test leads for continuity:

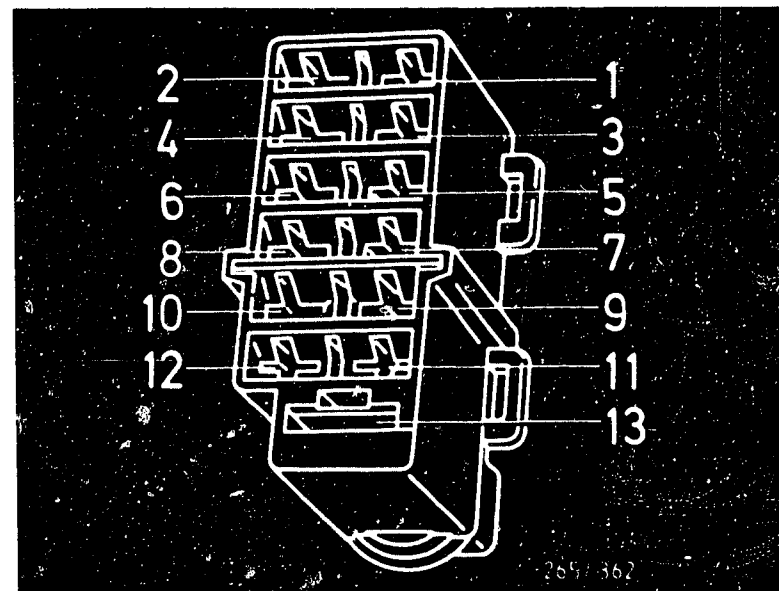
Valve VL (LED 4.1)  
between Y1/term. 3  
and controller plug  
X1/term. 2 .  
Valve VR (LED 4.2)  
between Y1/term. 5  
and controller plug  
X1/term. 35 .  
Valve H (LED 4.3)  
between Y1/term. 7  
and controller plug  
X1/term. 18 .

If test specification not  
obtained:  
test cable connection for  
open circuit, corrosion  
and mechanical defects.  
Eliminate open circuit.

3. All LEDs nos. 4 and 3 do  
not light up:

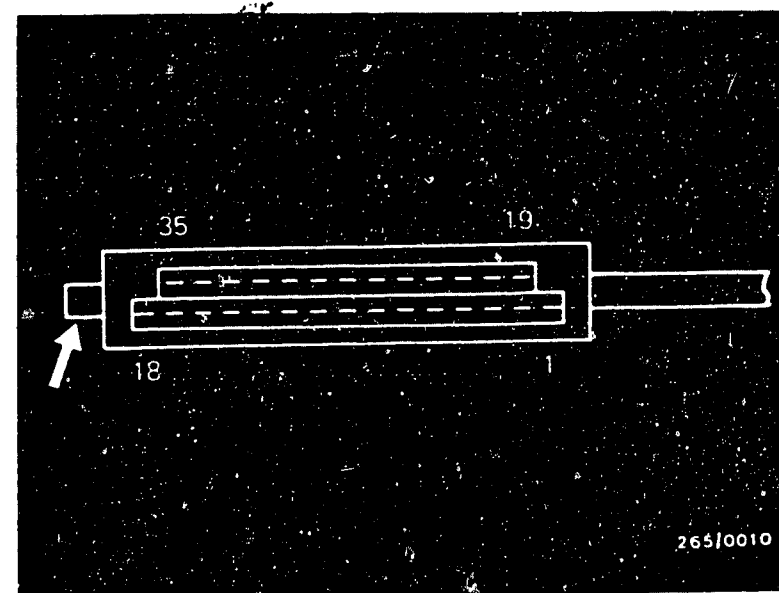
\* Test ground of valve  
relay for contact  
resistance and open  
circuit.  
From plug at Y1/term. 8 to  
ground terminal.

\* Valve relay defective.



Plug Y1 at hydraulic modulator,

Plan view of controller  
plug X1 (35-pin) with  
terminal numbers.  
Arrow = Lug with mechanical  
encoding



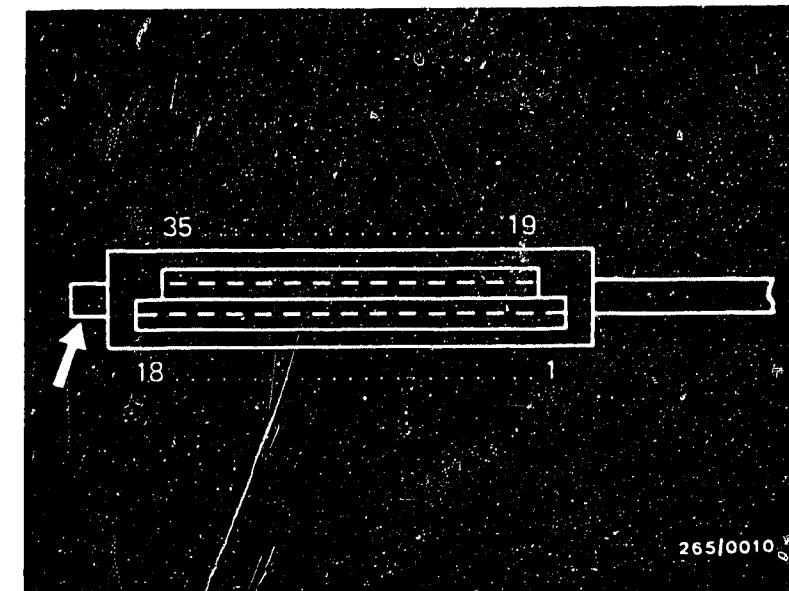
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## 4. Weak lighting of a LED:

- \* This means contact resistance in corresponding current path.

## 5. ABS warning lamp does not light up:

- \* Warning lamp defective.
- \* Test lead from the warning lamp to driving switch term. 15 and to controller plug X1/term.21 .  
Note:  
All other 6 LEDs must light up.



Plan view of controller plug X1 (35-pin) with terminal numbers.  
Arrow = Lug with mechanical encoding

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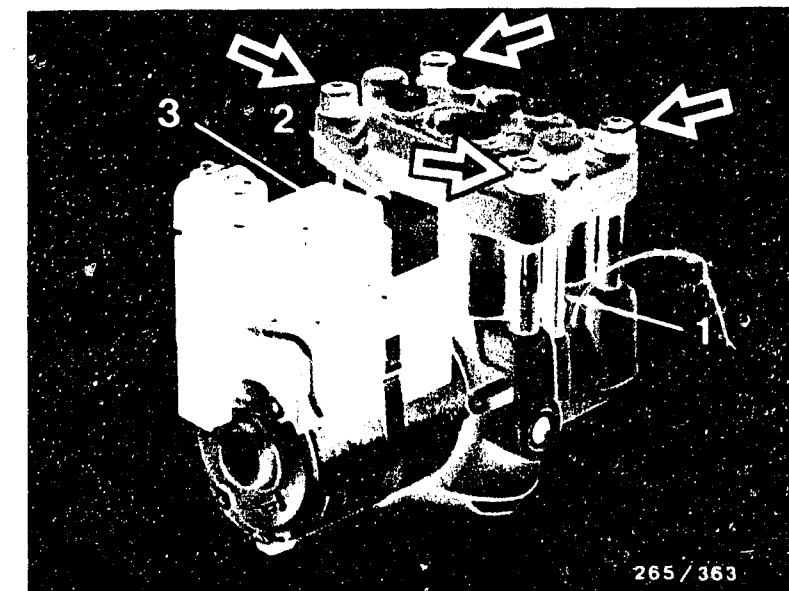
## Removing the hydraulic modulator:

- \* For reasons of safety, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.

Excepted from this are the motor and valve relays (upper illustration). Both relays may be exchanged.

- \* Apart from the brake-line connections, no screws on the hydraulic modulator must be loosened. In particular, the hexagon-socket-head cap screws and Torx screws must under no circumstances be loosened (upper illustration). Once they are loosened, it is impossible to make the brake circuits leak-free ever again.  
DANGER OF FATAL ACCIDENT!

- \* Check the hydraulic modulator and brake-line connections visually for leaks. If brake fluid is escaping, the brake-line connections must be tightened (see brief instructions) or replaced, and the hydraulic modulator exchanged.



1 = Hydraulic modulator

2 = Valve relay

3 = Motor relay

Arrows = Do not loosen these screws.

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At the base of the hydraulic modulator is a ventilation hole to the pump pistons. Small amounts of brake fluid may escape from this point. A complaint in this respect is justified only if a pool of brake fluid forms beneath the hydraulic modulator after the brake pedal is actuated several times.

- \* When removing and installing the brake lines, make sure the lines are marked in accordance with the markings on the hydraulic modulator and are re-connected correctly assigned (e.g. "VL" of hydraulic modulator must be connected to the front left wheel-brake cylinder).
- \* Marking on hydraulic modulator: (see illustration)

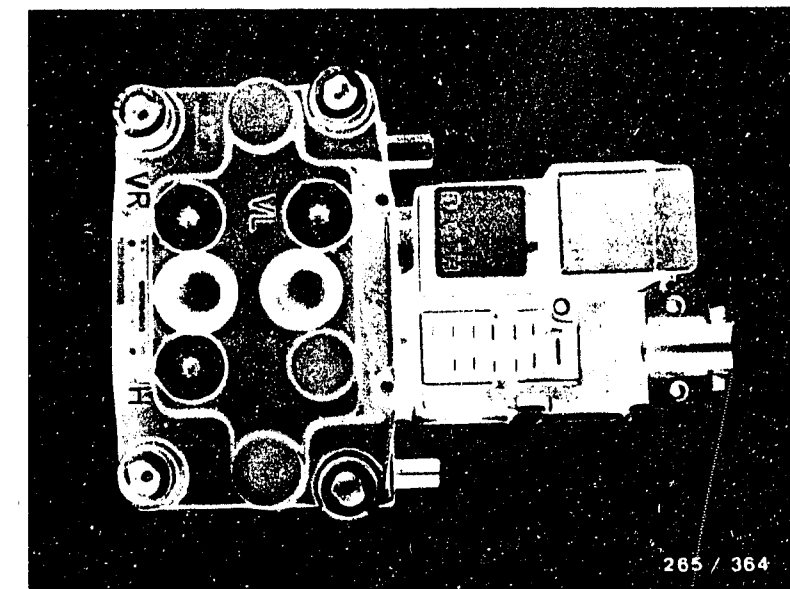
VL = Connection for brake line, front left (wheel-brake cylinder)

VR = Connection for brake line, front right (wheel-brake cylinder)

H = Connection for brake line of rear axle

v = Front-axle brake circuit from brake master cylinder

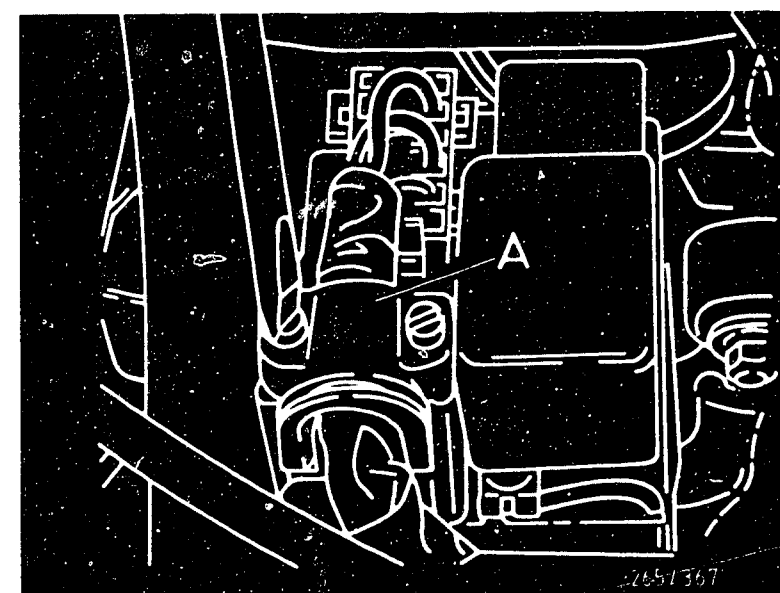
h = Rear-axle brake circuit from brake master cylinder



3-channel hydraulic modulator in housing of a 4-channel hydraulic modulator (with dummy solenoid-operated valve)

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- \* Use only the specified box wrench for loosening and tightening the brake lines.
- \* Mark the brake lines and loosen from hydraulic modulator. Upper illustration.
- \* Catch brake fluid and do not allow it to come into contact with the skin, clothing or paintwork!
- \* Immediately seal off brake lines and connections with dummy plugs.
- \* Disconnect ground cable from pump motor. Center illustration.
- \* Loosen fastening screws and remove hood.
- \* Loosen clip and remove the plug. Lower illustration.
- \* Loosen hexagon nuts from holder and remove hydraulic modulator.

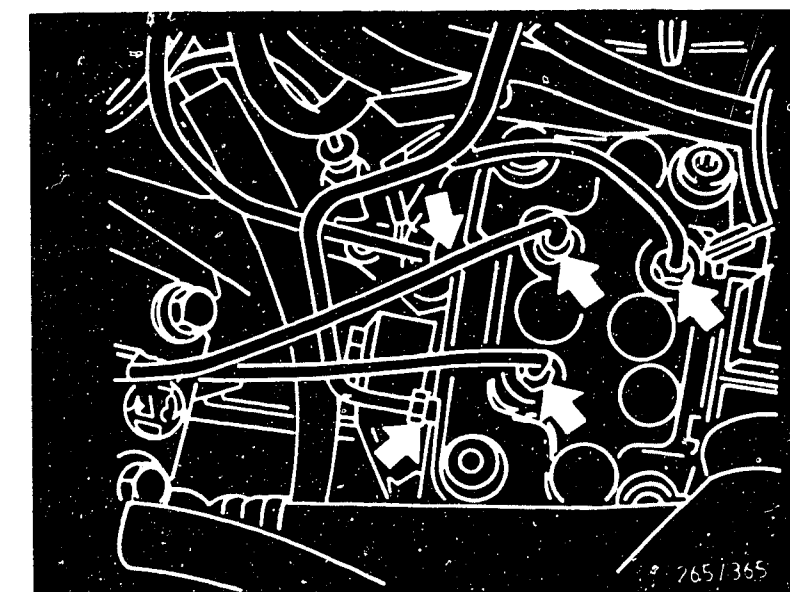
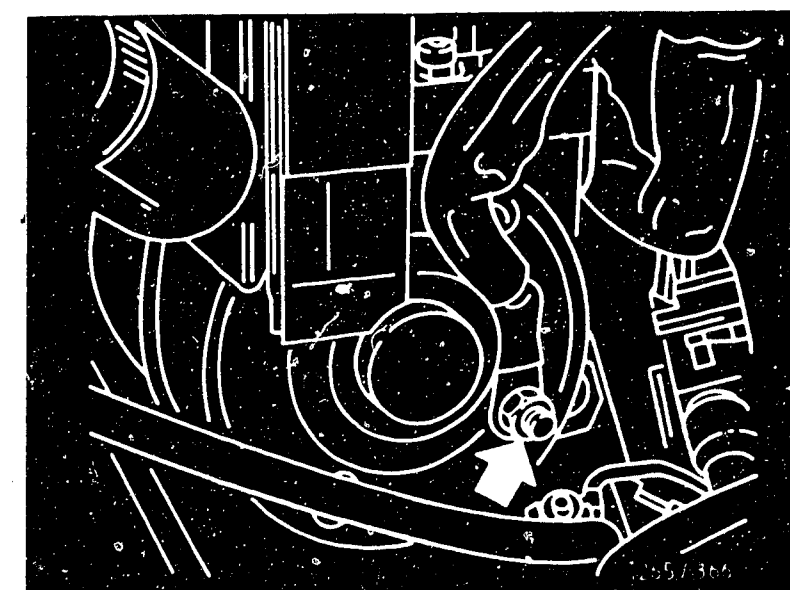
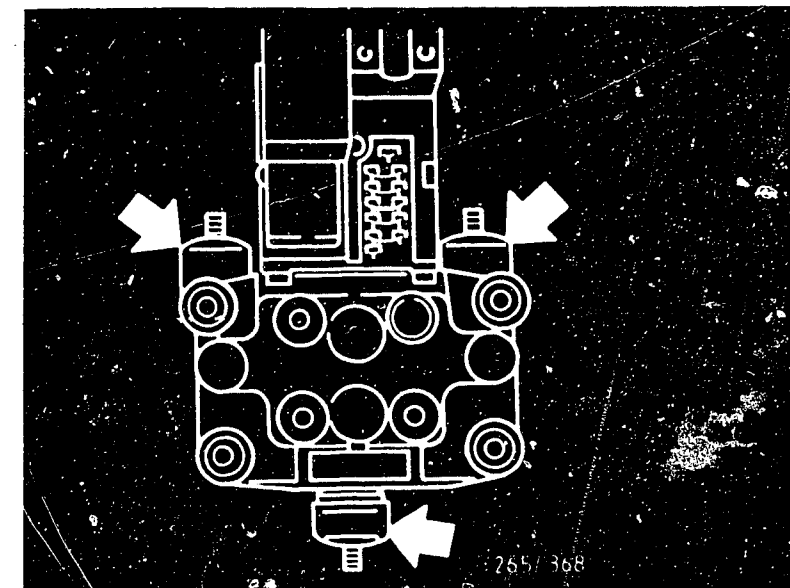


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## Installing

- \* Insert hydraulic modulator into the holder and secure with hexagon nuts. Upper illustration.
- \* Connect ground cable to pump motor. Center illustration. Connect 13-pin plug and secure with clip.
- \* Secure hood on to the hydraulic modulator using screw.
- \* Connect brake lines to the hydraulic modulator in accordance with markings. Lower illustration.
- \* Observe tightening torques for brake-line connections at hydraulic modulator.
- \* Bleed brake system and test for leakages.
- \* Check ABS completely with tester.



Component/Operation:

Generator voltage of term. 61  
(term. 15)

* Operation:	Position:
Program switch	2
Push-button	-

\* Operation in vehicle:  
Ignition on.

\* Test specification (indication):  
LED 1 (upper illustration) lights up.

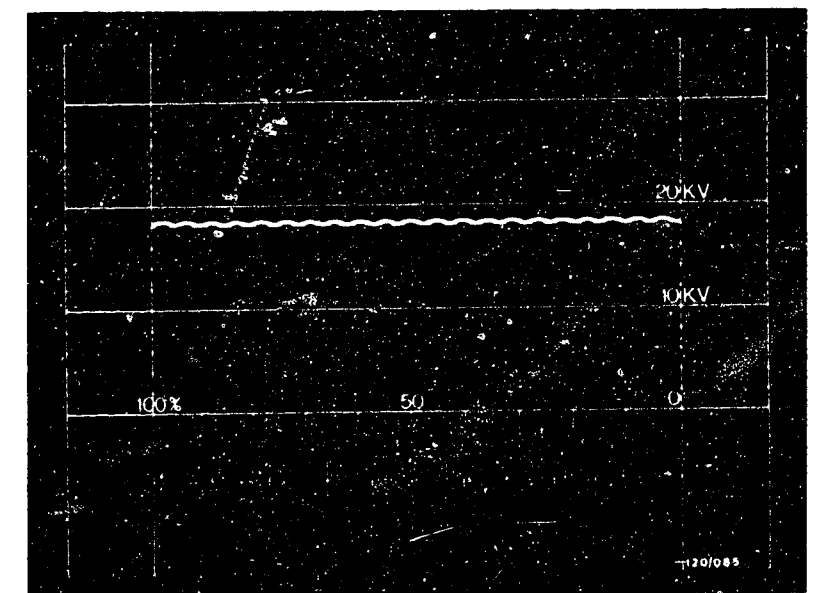
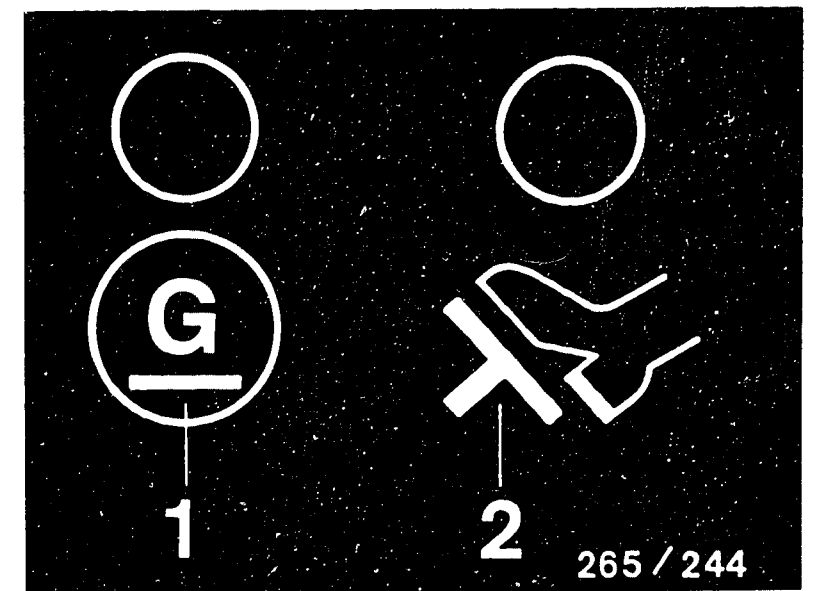
\* Operation in vehicle:  
Start engine.

\* Test specification (indication):  
LED 1 (upper illustration) goes out when engine running.

## Trouble-shooting:

LED 1 does not go out when engine running:

- \* Briefly accelerate.  
If LED 1 goes out, test is O.K.
- \* Voltage measurement at K1/  
term. 15 with engine running.  
Test specification: greater than 10 V.
- \* Oscilloscope measurement at K1/  
term. 15 with engine running.
- \* Voltage smaller than 10 V or  
pattern indicating defects.
- \* Repair generator and/or lead.



Continued on next picture page

## Component/Operation:

Stop-lamp switch term. 25.

N&gt;

\* Operation:  
Program switch  
Push-button

Position:  
2  
—

\* Operation in vehicle:  
Ignition on.

\* Test specification (indication):  
LED 2 (upper illustration) lights up.

\* Operation in vehicle:  
Actuate brake pedal.

\* Test specification (indication)  
LED 2 (upper illustration) goes out.

## Trouble-shooting:

1. LED 2 does not light up:

\* Stop lamps defective.  
High contact resistance of stop lamps or of their ground.  
Break in line from controller term. 25 to stop-lamp switch.

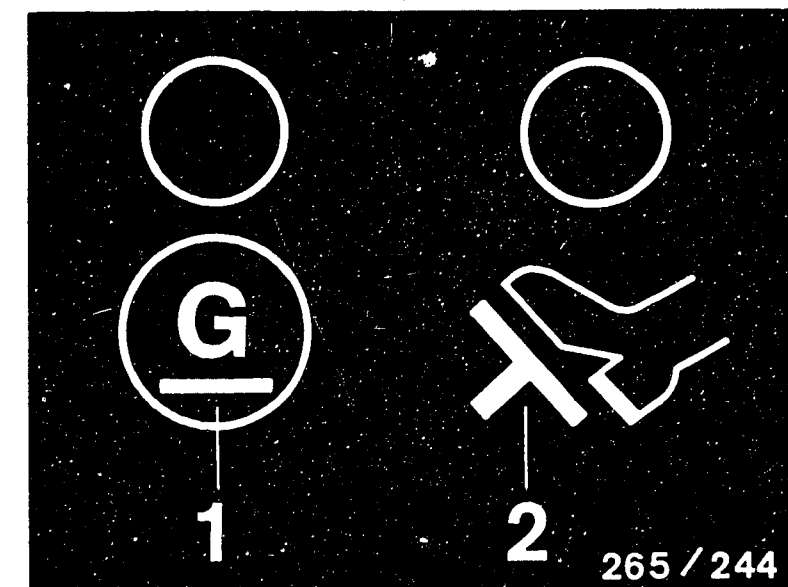
2. LED does not go out or becomes only slightly darker:

\* Fuse for stop-lamp switch defective.

\* Voltage drop at stop-lamp switch (switch defective) or its plug connections.

\* Stop-lamp switch defective.

\* Lead to stop-lamp switch connected incorrectly.



Continued on next picture page

Component/Operation:

Pump-motor motor relay in hydraulic modulator  
(term.28, term.14).

* Operation:	Position:
Program switch	3
Push-button (upper ill.)	2

\* Operation in vehicle:  
Ignition on.  
Keep push-button 2 (upper ill.) pressed.

\* Test specification (indication):  
LED 1 lights up, pump motor runs.

After releasing the push-button,  
LED 1 stays lit due to run-on of  
motor (upper illustration).

## Trouble-shooting:

Switch off ignition:

1. LED does not light up  
or pump motor does not  
start:

\* Motor relay defective  
(lower illustration).

\* Test following leads for  
continuity:

From controller plug  
X1/term. 14 to hydraulic-  
modulator-plug  
term. 9 .  
From hydraulic modulator  
term.9 to motor relay term. 30.

From overvoltage-protection  
relay term.30a to  
Y2/term. 2

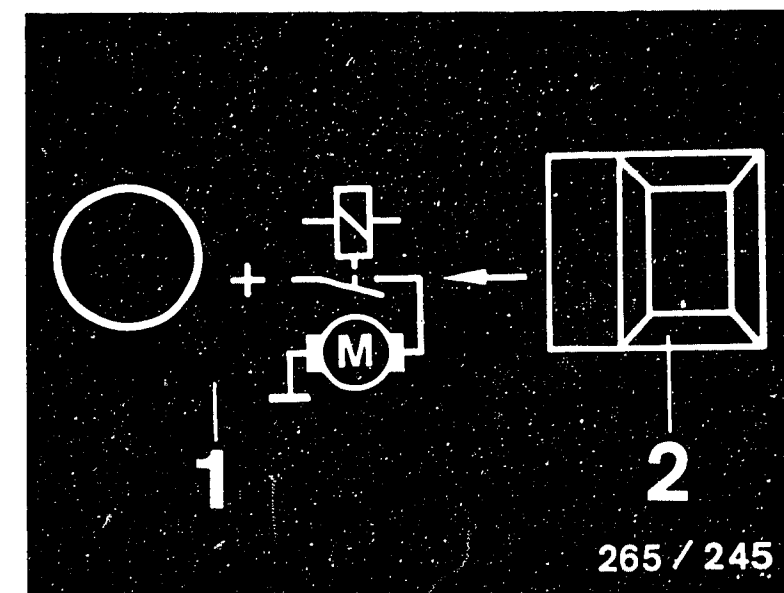
From hydraulic modulator  
term. 2 to motor relay term. 86

From motor relay term. 85  
to hydraulic modulator term. 11

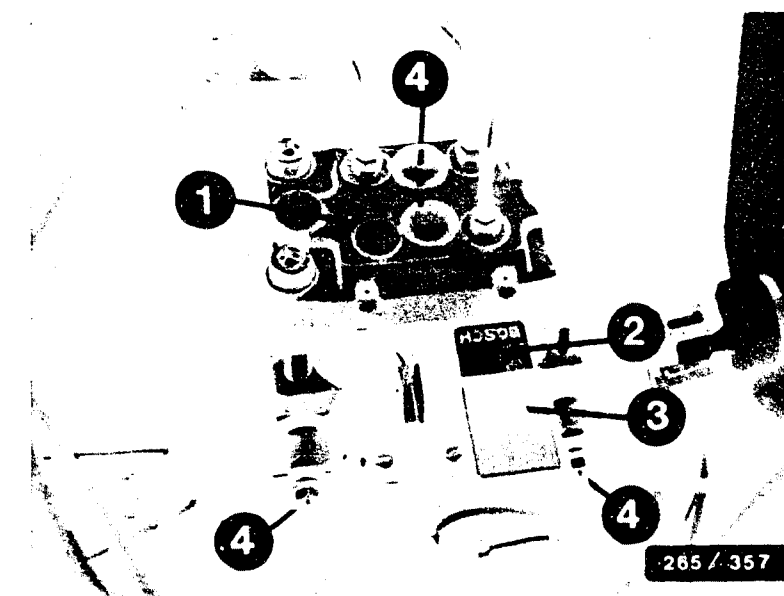
From Y2/term. 11 to controller  
plug X1/term. 28

From motor relay term. 87 to  
X1/term. 13.

From Y2/term. 13 to term. B+.



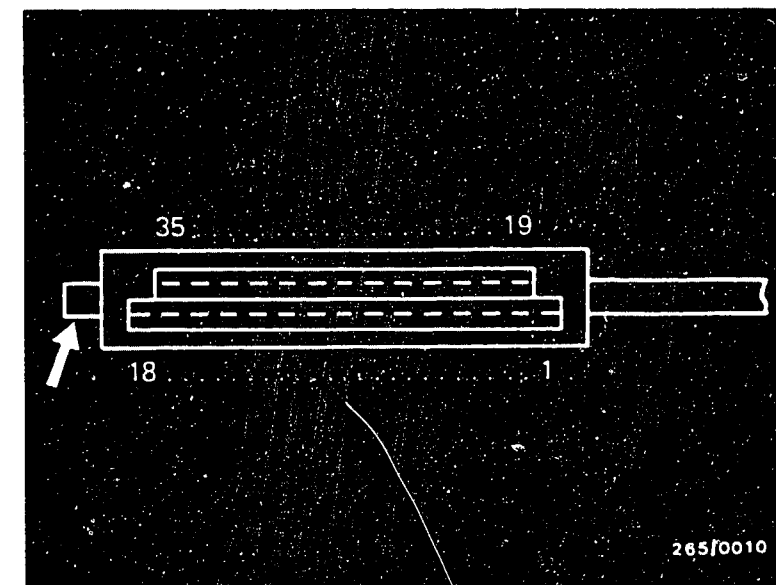
1 = Hydraulic modulator  
2 = Valve relay  
3 = Motor relay  
4 = Fastening nuts



Continued C17

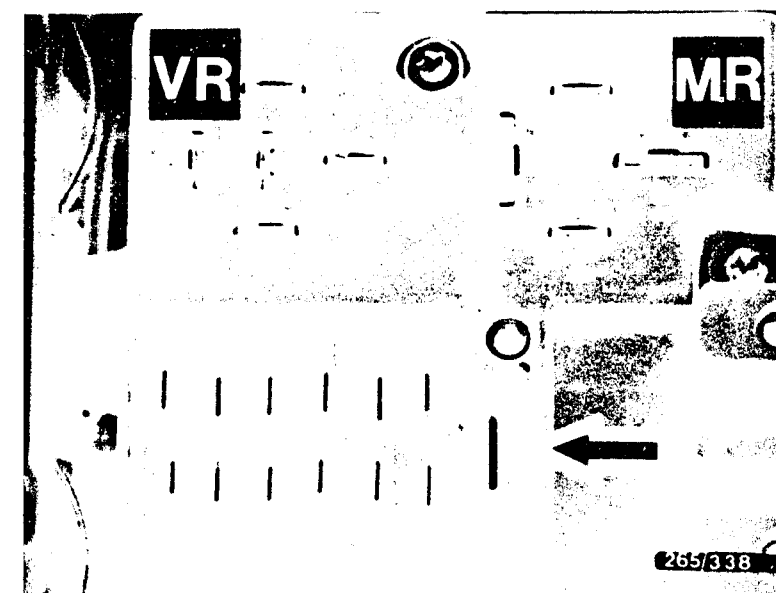
Continued on next picture page

2. Pump motor does not run or LED does not stay lit or stays lit very briefly:
- \* Check for firm seating of ground terminal of pump motor and test contact resistance.
  - \* Test for firm seating of positive connection of pump motor. Test lead from positive connection of pump motor to motor relay term. 30. Test pump motor for continuity.
  - \* Pump motor defective: exchange hydraulic modulator.



Plan view of controller plug X1 (35-pin) with terminal numbers.  
Arrow = Lug with mechanical encoding

Pluggable printed-board assembly, hydraulic modulator, position of terminals: VR = Valve relay  
MR = Motor relay  
Arrow = Hydraulic-modulator plug



Continued on next picture page

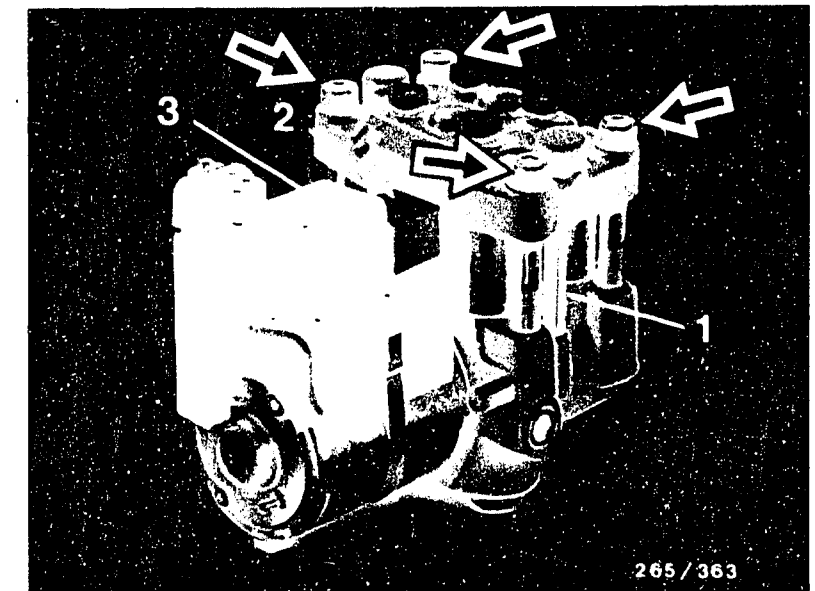
Removing the hydraulic modulator:

- \* For reasons of safety, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.

Excepted from this are the motor and valve relays (upper illustration). Both relays may be exchanged.

- \* Apart from the brake-line connections, no screws on the hydraulic modulator must be loosened. In particular, the hexagon-socket-head cap screws and Torx screws must under no circumstances be loosened (upper illustration). Once they are loosened, it is impossible to make the brake circuits leak-free ever again.  
DANGER OF FATAL ACCIDENT!

- \* Check the hydraulic modulator and brake-line connections visually for leaks. If brake fluid is escaping, the brake-line connections must be tightened (see brief instructions) or replaced, and the hydraulic modulator exchanged.



- 1 = Hydraulic modulator
- 2 = Valve relay
- 3 = Motor relay
- Arrows = Do not loosen these screws.

Continued on next picture page

At the base of the hydraulic modulator is a ventilation hole to the pump pistons. Small amounts of brake fluid may escape from this point. A complaint in this respect is justified only if a pool of brake fluid forms beneath the hydraulic modulator after the brake pedal is actuated several times.

- \* When removing and installing the brake lines, make sure the lines are marked in accordance with the markings on the hydraulic modulator and are re-connected correctly assigned (e.g. "VL" of hydraulic modulator must be connected to the front left wheel-brake cylinder).
- \* Marking on hydraulic modulator: (see illustration)

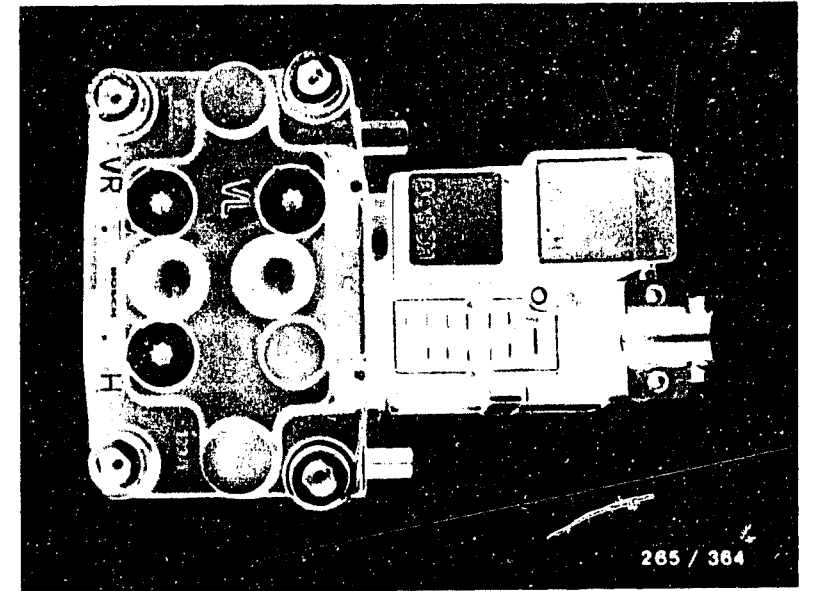
VL = Connection for brake line, front left (wheel-brake cylinder)

VR = Connection for brake line, front right (wheel-brake cylinder)

H = Connection for brake line of rear axle

v = Front-axle brake circuit from brake master cylinder

h = Rear-axle brake circuit from brake master cylinder



3-channel hydraulic modulator in housing of a 4-channel hydraulic modulator (with dummy solenoid-operated valve)

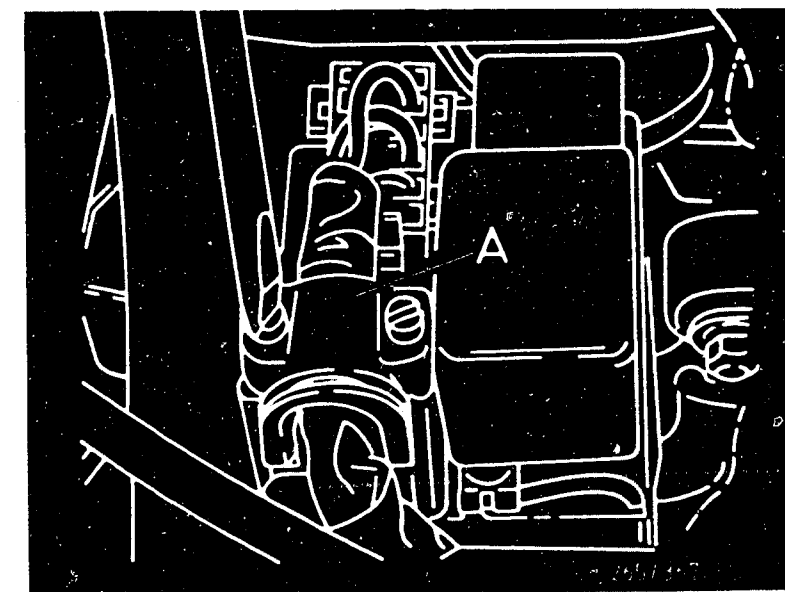
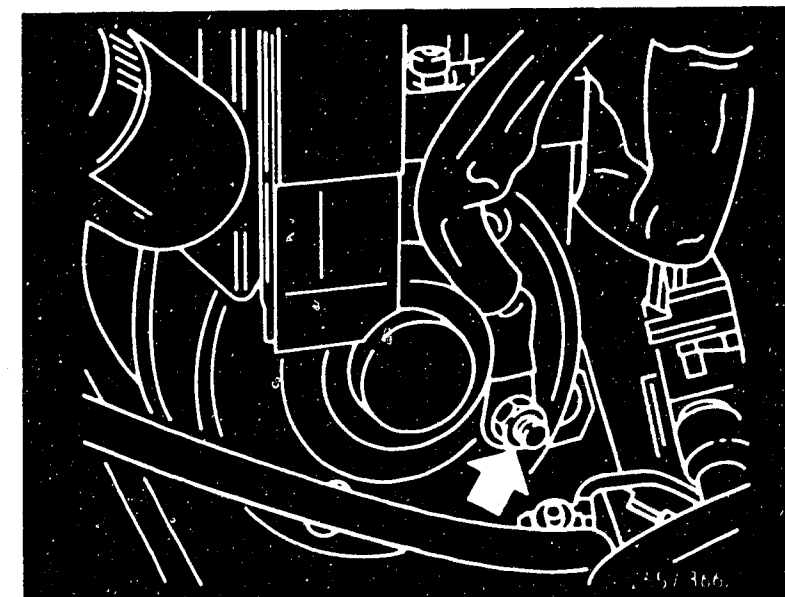
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V

- \* Use only the specified box wrench for loosening and tightening the brake lines.
- \* Mark the brake lines and loosen from hydraulic modulator. Upper illustration.
- \* Catch brake fluid and do not allow it to come into contact with the skin, clothing or paintwork!
- \* Immediately seal off brake lines and connections with dummy plugs.
- \* Disconnect ground cable from pump motor. Center illustration.
- \* Loosen fastening screws and remove hood.
- \* Loosen clip and remove the plug. Lower illustration.
- \* Loosen hexagon nuts from holder and remove hydraulic modulator.

V

Continued on next picture page

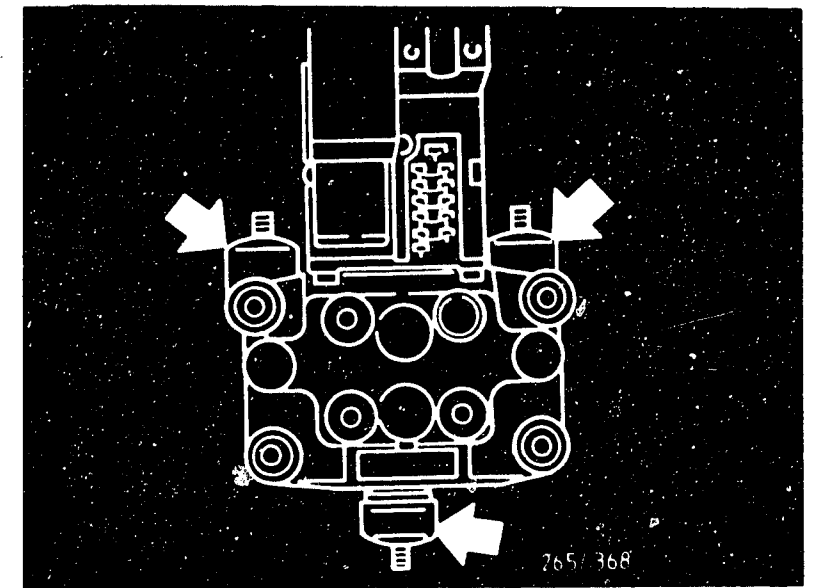






## Installing

- \* Insert hydraulic modulator into the holder and secure with hexagon nuts. Upper illustration.
- \* Connect ground cable to pump motor. Center illustration. Connect 13-pin plug and secure with clip.
- \* Secure hood on to the hydraulic modulator using screw.
- \* Connect brake lines to the hydraulic modulator in accordance with markings. Lower illustration.
- \* Observe tightening torques for brake-line connections at hydraulic modulator.
- \* Bleed brake system and test for leakages.
- \* Check ABS completely with tester.



Test step for program-switch position 4 not applicable.

Component/Operation:

Valve-relay operation term. 27

\* Operation:

Program switch

Push-button

Position:

5

-

\* Operation in vehicle:

Ignition on.

\* Test specification (indication):

LED 3 (upper illustration)

lights up.

Trouble-shooting:

Switch off ignition.

No reading:

\* Test following leads for open circuit and contact resistance:

From X1/term. 27 to hydraulic-modulator plug term. 6 .

From X1/term. 32 to hydraulic-modulator plug term. 12 .

From hydraulic modulator term. 12 to valve relay term.30.

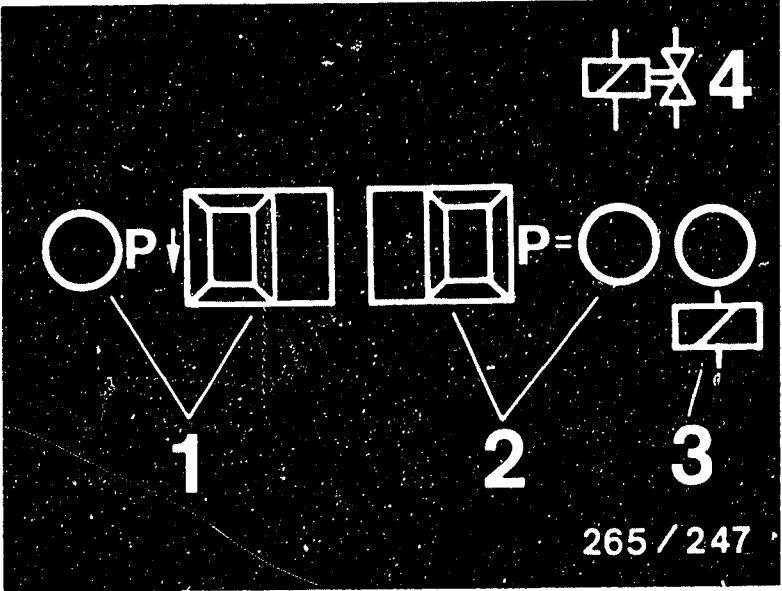
From hydraulic modulator term. 6 to valve relay term.85.

From hydraulic modulator term. 4 to valve relay term.87.

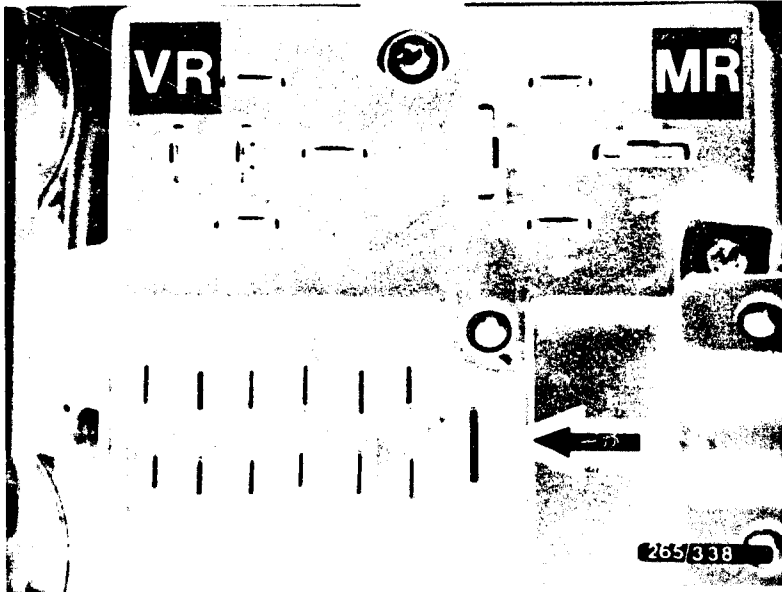
From hydraulic-modulator plug term. 4 to B+ .

From valve relay term. 86 to motor relay term. 86.

\* Valve relay defective: exchange.



Pluggable printed-board assembly, hydraulic modulator, position of terminals: VR = Valve relay  
MR = Motor relay  
Arrow = Hydraulic-modulator plug



Continued on next picture page

Continued on next picture page

Component/Operation:

Check operation and for mix-up of solenoid-operated valves in hydraulic modulator.

Pressure-holding function  
point 1 to 3 and  
Pressure-release function  
point 4 to 5.

Note:

Check each wheel separately in turn, observe operating sequence.

* Operation:	Position:
Program switch	5

\* Operation in vehicle and at tester:

Chock up vehicle. The wheel being tested must be freely turnable by hand.

Ignition on.

Set switch 1 (upper ill.) for wheel selection to wheel to be tested.

1. (Lower illustration)

Push-button P = keep pressed  
Test specification:  
LED P = lights up.

N&gt;

1. LED P (lower illustration) does not light up:

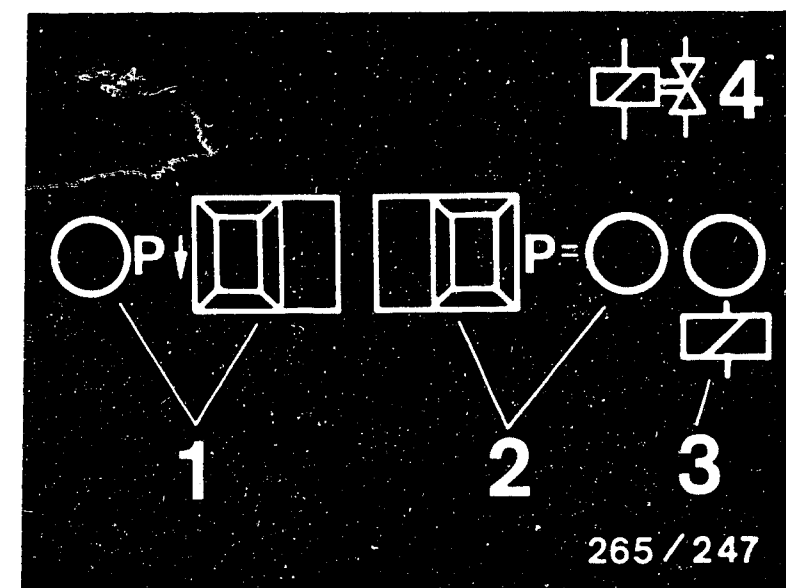
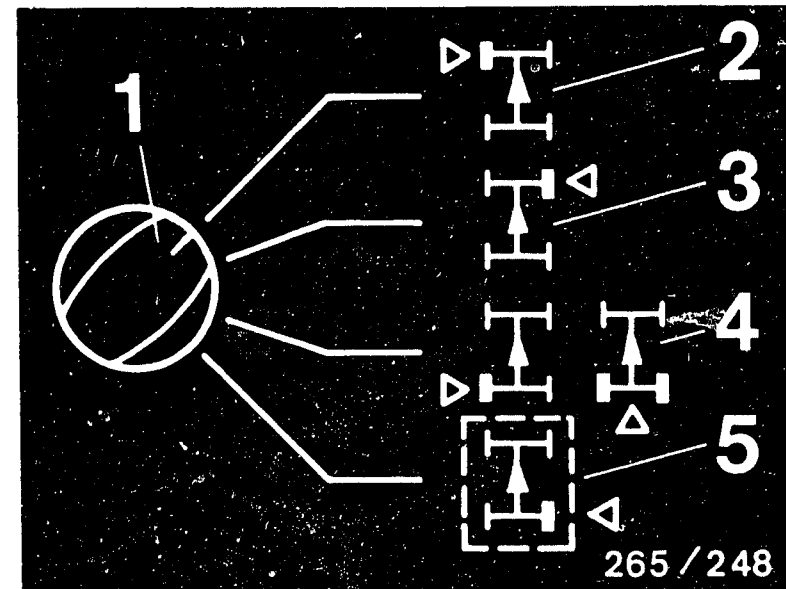
- \* Battery insufficiently charged.
- \* Repeat test with engine running.
- \* Valve relay (make contact) defective.
- \* Ground terminals must be bare and firmly connected.

Test following leads for voltage drop and open circuit.

- \* Lead from controller plug X1/term. 10 to ground.
- \* Lead from controller plug X1/term. 34 to ground.
- \* Positive lead from controller plug X1/term. 1 to overvoltage-protection relay term. 30a.
- \* Lead from valve relay term. 87 to B+.

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Continued on next picture page



2. Constantly press brake pedal.

Test specification:  
Wheel turnable by hand.

3. Release push-button P=,  
(upper illustration)

Test specification:  
LED P= goes out,  
wheel locks.

Pressure reduction:

4. Press push-button P arrow  
(upper illustration)

Test specification:  
LED P arrow lights up,  
Wheel turnable by hand.

5. Release push-button P arrow  
(upper illustration)

Test specification:  
LED P arrow goes out,  
wheel locks.

6. Release brake pedal.

Continued D03

2. Wheel locks or wheel  
cannot be turned:

- \* Hydraulic brake lines at hydraulic modulator (lower illustration) mixed up.
- \* Solenoid-operated valves correctly electrically connected?

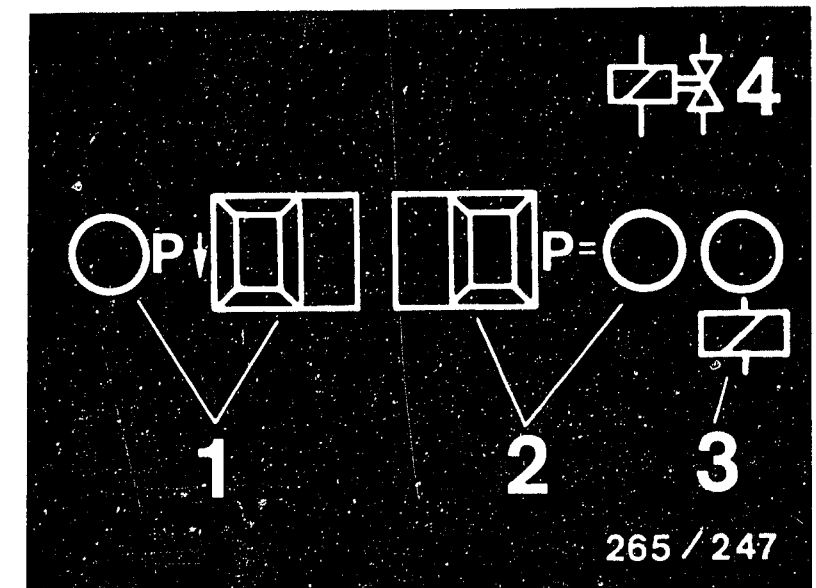
Wheel, front left:  
from controller plug  
X1/term. 2 to hydraulic-  
modulator plug term. 3

Wheel, front right:  
from controller plug  
X1/term. 35 to hydraulic-  
modulator plug Y1/term. 5

Rear axle:  
From controller plug  
X1/term. 18 to hydraulic  
modulator plug term. 7

- \* Test ground strap of pump for firm seating.  
Terminal connections must be bare.
- \* Test positive connection of pump for voltage drop and firm seating.  
Connection must be bare and firmly tightened.
- \* Hydraulic modulator defective.

Continued on next picture page



## Removing the hydraulic modulator:

- \* For reasons of safety, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.

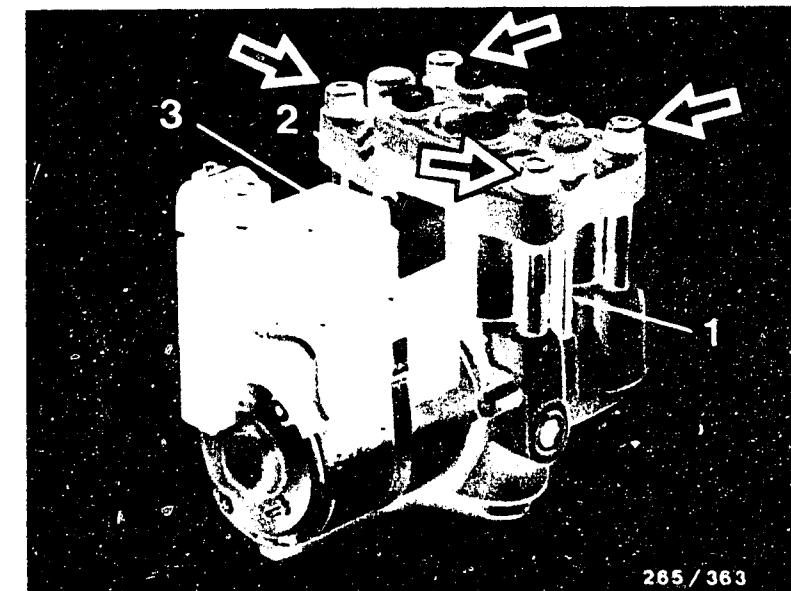
Excepted from this are the motor and valve relays (upper illustration). Both relays may be exchanged.

- \* Apart from the brake-line connections, no screws on the hydraulic modulator must be loosened.

In particular, the hexagon-socket-head cap screws and Torx screws must under no circumstances be loosened (upper illustration).

Once they are loosened, it is impossible to make the brake circuits leak-free ever again.  
**DANGER OF FATAL ACCIDENT !**

- \* Check the hydraulic modulator and brake-line connections visually for leaks. If brake fluid is escaping, the brake-line connections must be tightened (see brief instructions) or replaced, and the hydraulic modulator exchanged.



1 = Hydraulic modulator

2 = Valve relay

3 = Motor relay

Arrows = Do not loosen these screws.

Continued on next picture page

At the base of the hydraulic modulator is a ventilation hole to the pump pistons. Small amounts of brake fluid may escape from this point. A complaint in this respect is justified only if a pool of brake fluid forms beneath the hydraulic modulator after the brake pedal is actuated several times.

- \* When removing and installing the brake lines, make sure the lines are marked in accordance with the markings on the hydraulic modulator and are re-connected correctly assigned (e.g. "VL" of hydraulic modulator must be connected to the front left wheel-brake cylinder).
- \* Marking on hydraulic modulator: (see illustration)

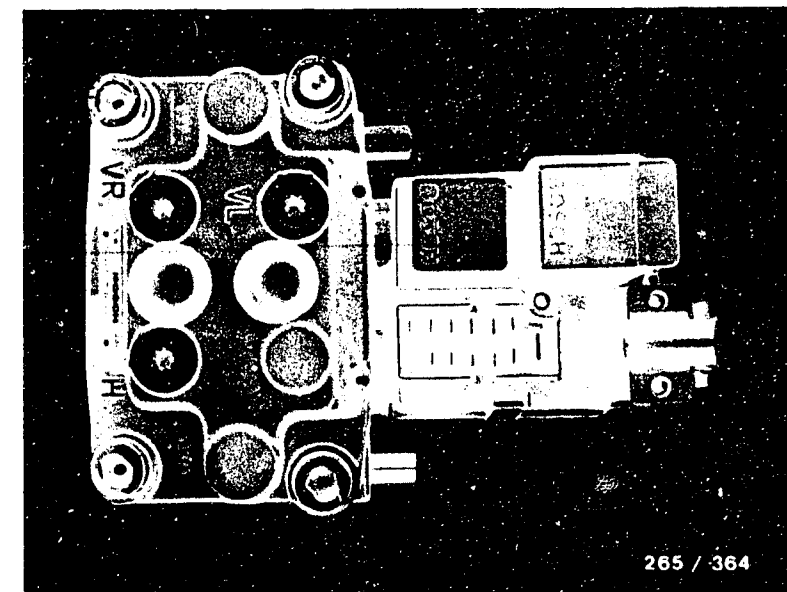
VL = Connection for brake line, front left (wheel-brake cylinder)

VR = Connection for brake line, front right (wheel-brake cylinder)

H = Connection for brake line of rear axle

v = Front-axle brake circuit from brake master cylinder

h = Rear-axle brake circuit from brake master cylinder

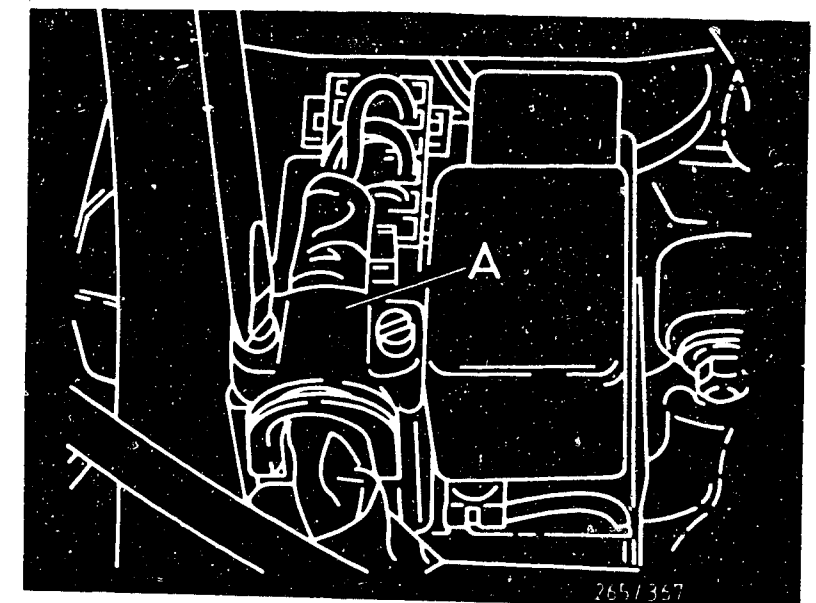


3-channel hydraulic modulator in housing of a 4-channel hydraulic modulator (with dummy solenoid-operated valve)

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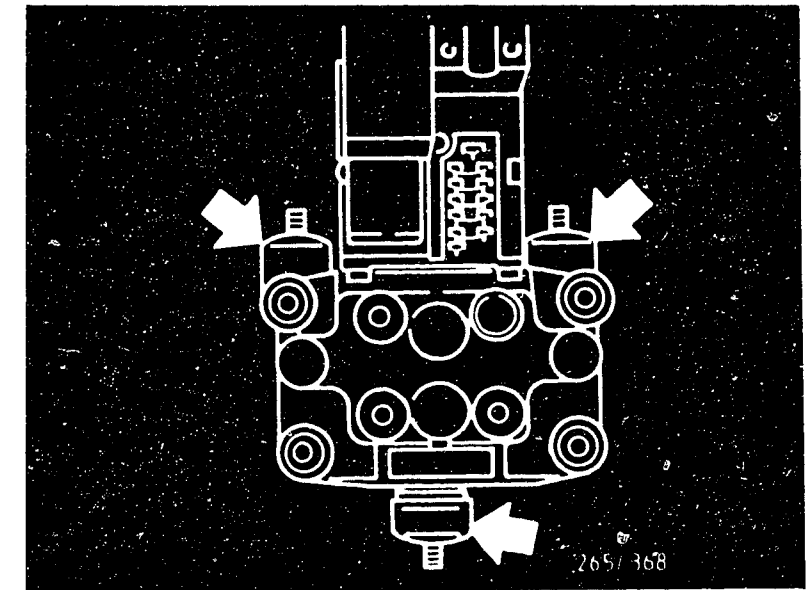
- \* Use only the specified box wrench for loosening and tightening the brake lines.
- \* Mark the brake lines and loosen from hydraulic modulator. Upper illustration.
- \* Catch brake fluid and do not allow it to come into contact with the skin, clothing or paintwork!
- \* Immediately seal off brake lines and connections with dummy plugs.
- \* Disconnect ground cable from pump motor. Center illustration.
- \* Loosen fastening screws and remove hood.
- \* Loosen clip and remove the plug. Lower illustration.
- \* Loosen hexagon nuts from holder and remove hydraulic modulator.

Continued on next picture page



## Installing

- \* Insert hydraulic modulator into the holder and secure with hexagon nuts. Upper illustration.
- \* Connect ground cable to pump motor. Center illustration. Connect 13-pin plug and secure with clip.
- \* Secure hood on to the hydraulic modulator using screw.
- \* Connect brake lines to the hydraulic modulator in accordance with markings. Lower illustration.
- \* Observe tightening torques for brake-line connections at hydraulic modulator.
- \* Bleed brake system and test for leakages.
- \* Check ABS completely with tester.





## Component/Operation:

Checking the wheel-speed sensors for operation and mix-up.

## Note:

Check each wheel separately in turn. The rear axle can be checked at either the left or right wheel.

\* Operation:                      Position:  
Program switch                      6

\* Operation in vehicle and tester:

Chock up vehicle.

Ignition on.

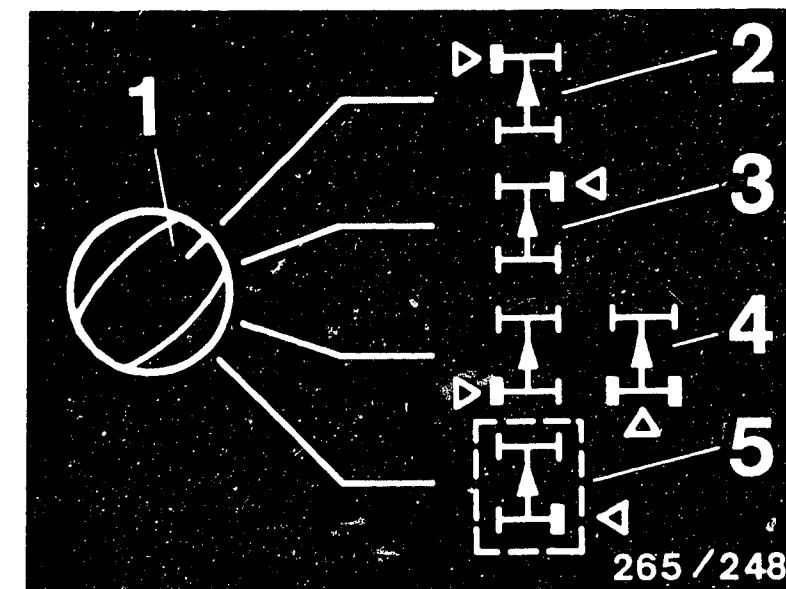
The wheel to be tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked.

Set the switch for wheel selection to the wheel to be tested (upper illustration).

Turn the wheel by hand until LED 2 above the instrument lights up without flickering. (Speed approx. 1 revolution per second).

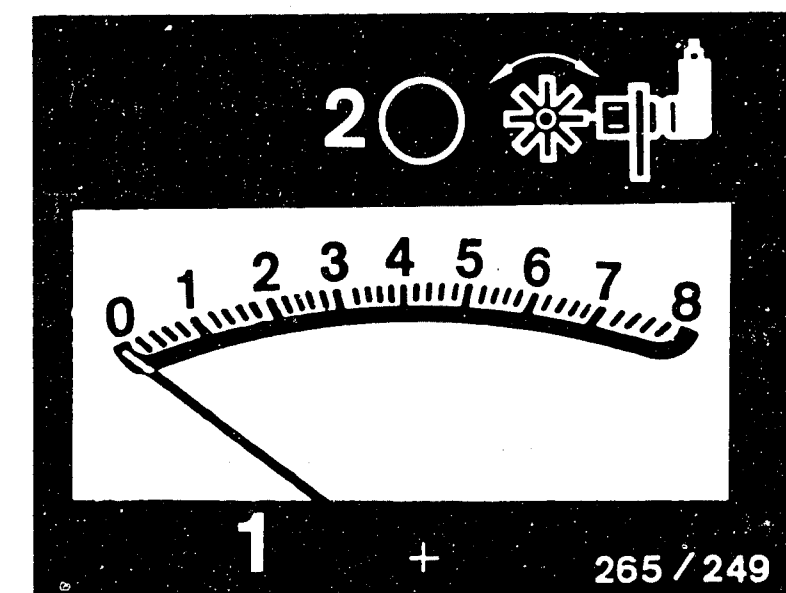
## Trouble-shooting:

- \* 1. LED (lower illustration) does not light up.
- \* Driven speed of wheel too low or too high.
- \* Ring gear with incorrect number of teeth or ring gear missing or loose.
- \* Number of teeth:  
front axle: 48 teeth  
rear axle : 48 teeth
- \* Loose contact in wheel-speed-sensor lead.
- 2. LEDs and instrument indicator light up in incorrect switch position:
- \* Plug-in connections of wheel-speed sensors mixed up.
- \* Leads at plug X1 incorrectly connected.
- \* Check terminal assignment according to terminal diagram.



- 1 = Wheel selector switch
- 2 = Wheel, front left
- 3 = Wheel, front right
- 4 = Wheel, rear left or rear axle
- 5 = Wheel, rear right

- 1 = Instrument
- 2 = LED for wheel speed



Continued on next picture page

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# TEST STEP 6 (CONTINUED 1) ( TEST SPECIFICATIONS AND OPERATING INSTRUCTIONS )

Then read off reading at instrument.

Test specification (reading).

- \* Smallest reading = larger 1,0 divisions.
- \* Permissible fluctuation max. 25 % of greatest reading.

Take for a road test for final check.

Warning lamp must go out with engine running.

Drive at at least 30 km/h. Warning lamp must not light up again.

If no fault can be found with the LED tester, check for loose contacts or rubbed locations in the leads, or exchange controller.

Ignition off.

3. No instrument reading:
- \* Test wheel-speed sensor for open circuit. Pull apart plug-in connection and measure the winding resistance using ohmmeter:

TEST SPECIFICATION:

Front axle:

0.6...1.6 k  $\Omega$

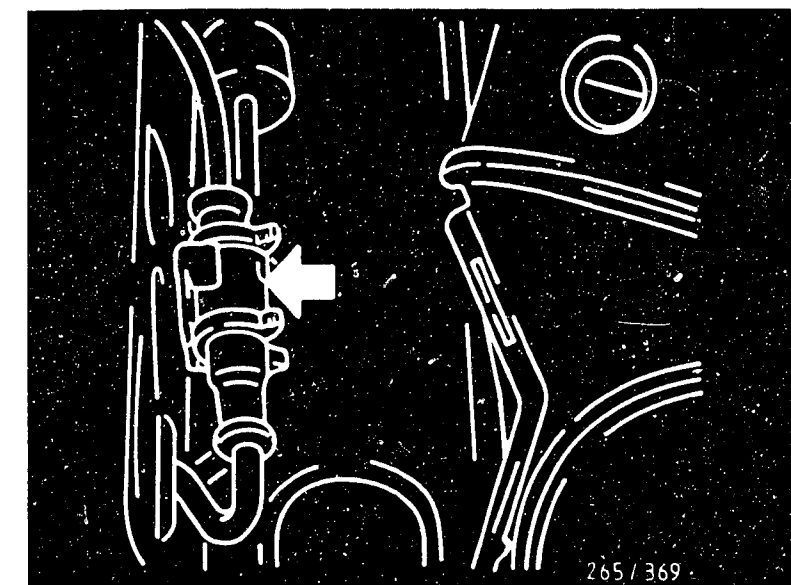
Rear axle :

0.6...1.6 k  $\Omega$

Test following wheel-speed-sensor leads for open circuit.

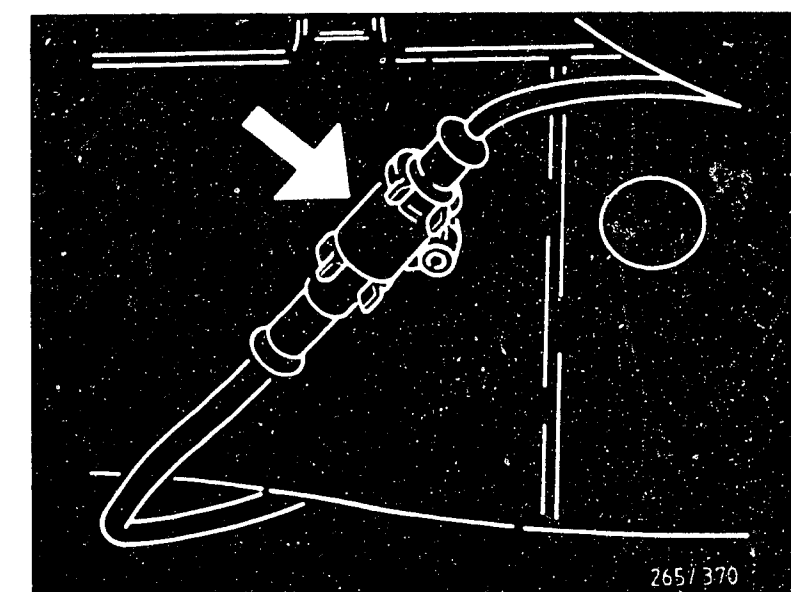
- \* Wheel, front left: from controller plug X1/term. 6 and term. 4 to plug-in connection X 2.
- \* Wheel, front right: from controller plug X1/term. 11 and term. 21 to plug-in connection X 3.
- \* Wheel, rear left: from controller plug X1/term. 8 and term. 9 to plug-in connection X 4.
- \* Wheel, rear right: from controller plug X1/term. 24 and term. 26 to plug-in connection X 5.

Continued on next picture page



Arrow = Wheel-speed-sensor plug connection, front right

Arrow = Wheel-speed-sensor plug-in connection at the rear on vehicle chassis



4. Instrument reading  
smaller than or near to 1,0:

- \* Air gap between wheel-speed sensor and ring gear too wide.
- \* Nominal dimension  
Front axle: 0,2...1,2 mm  
Rear axle : 0,5...1,5 mm
- \* Ring gear defective or loose  
or with incorrect number  
of teeth.

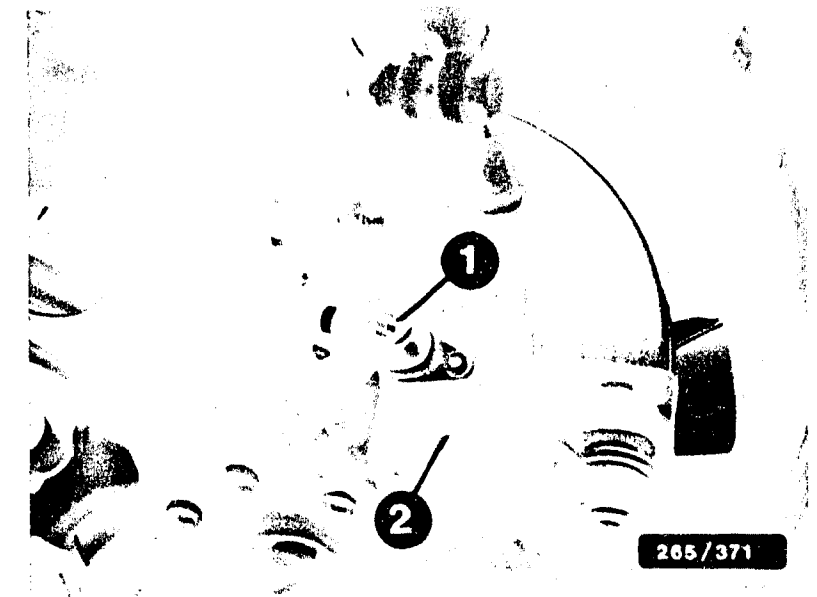
Front axle: 48 teeth

Rear axle : 48 teeth

- \* Wheel-speed sensor defective:  
exchange.

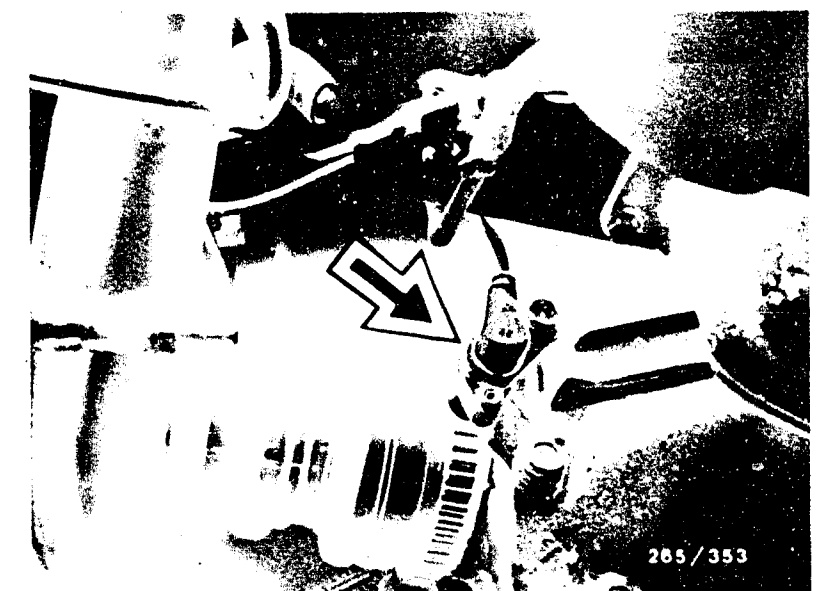
5. Fluctuation too great:

- \* Wheel-bearing clearance too  
large.
- \* Ring gear defective.
- \* Ring gear out-of-center.



1 = Wheel-speed sensor,  
front axle  
2 = Mounting plate

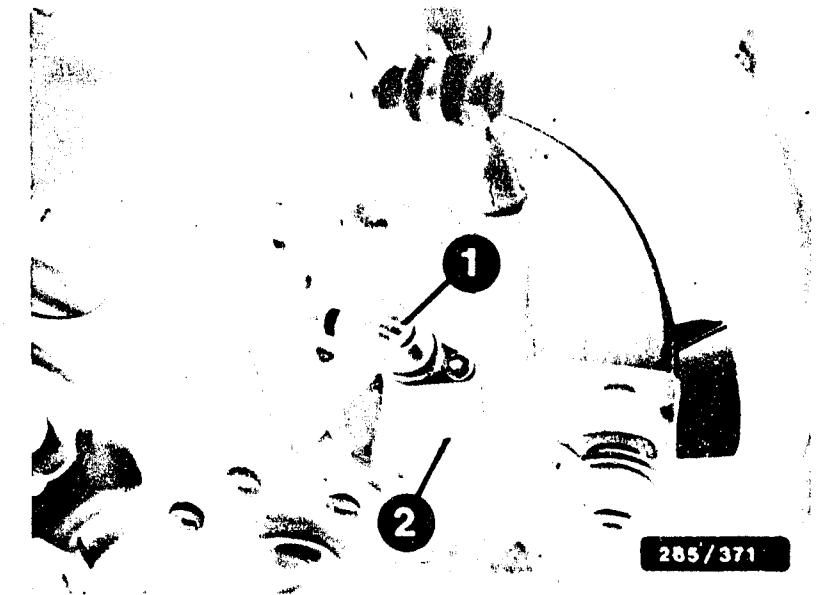
Arrow = Wheel-speed sensor,  
rear axle left



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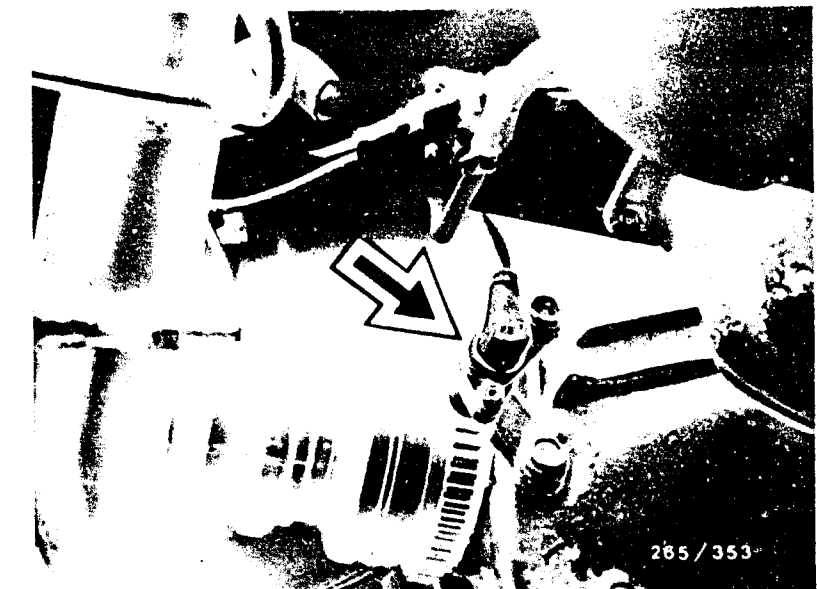
## Removing wheel-speed sensor:

- \* The plug-in connections for the front axle are located in the engine compartment and those for the rear axle on the vehicle chassis.
- \* Remove plug-in connections from bracket and pull apart.
- \* Loosen fastening screws of wheel-speed sensor and carefully remove wheel-speed sensor. Do not use force.



1 = Wheel-speed sensor,  
front axle  
2 = Mounting plate

Arrow = Wheel-speed sensor,  
rear axle left



Continued on next picture page

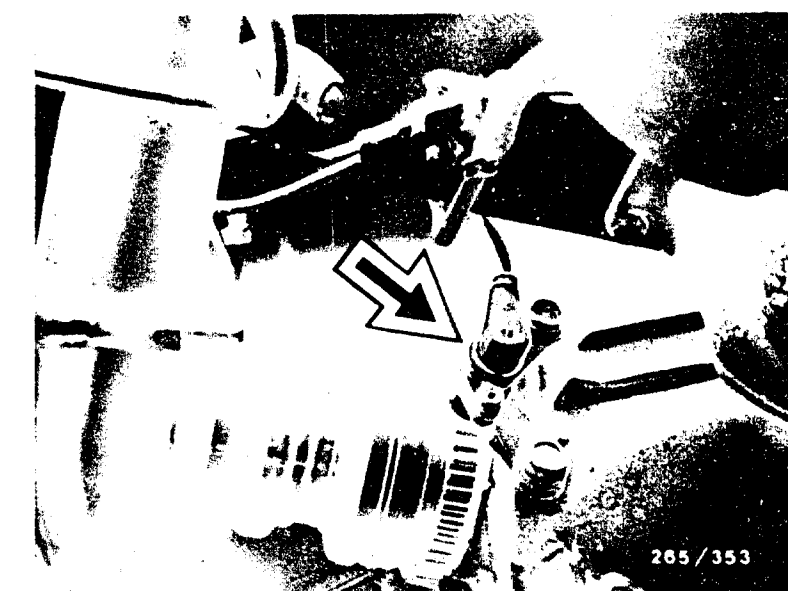
Installing wheel-speed sensor

- \* Remove new wheel-speed sensor from protective sleeve only immediately before assembling.
- \* Slightly grease wheel-speed-sensor housing with lubricant Molykote Longterm 2.
- \* Make sure that there are no metallic foreign bodies on the permanent-magnet edge.
- \* Carefully press wheel-speed sensor into locating bore as far as it will go.  
(For air gap, see brief instructions)  
Do not hit with hammer or similar object!



1 = Wheel-speed sensor, front axle  
2 = Mounting plate

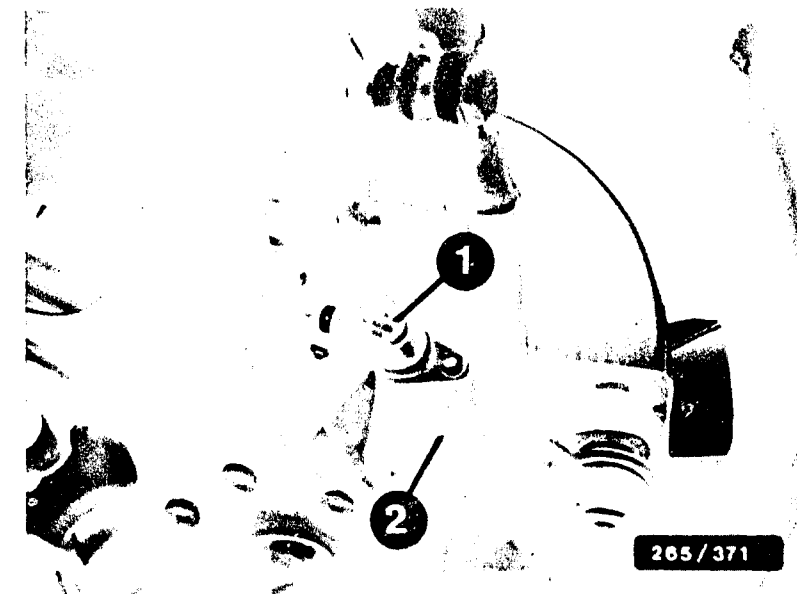
Arrow = Wheel-speed sensor, rear axle left



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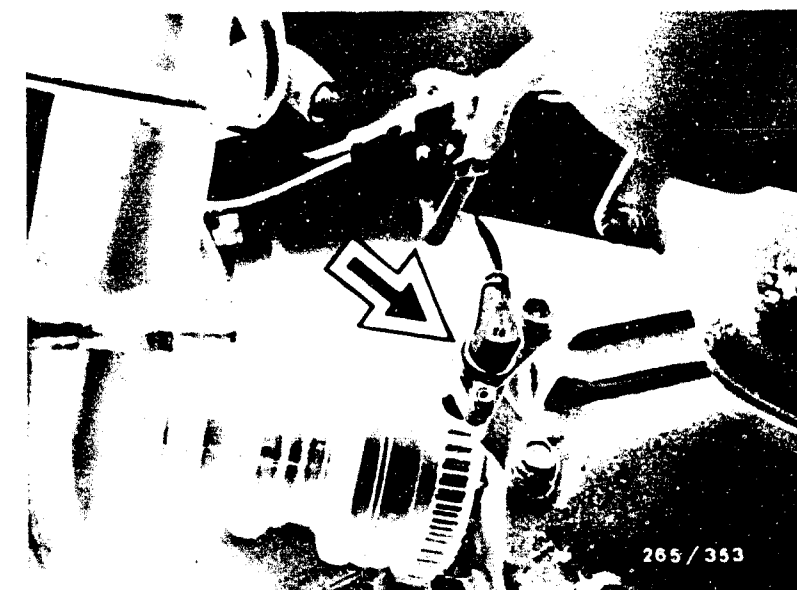


- \* Use new microencapsulated fastening screws. Tighten fastening screws to at least (see brief instructions) Nm.
- \* Secure lead once again at the locations provided.
- \* Connect wheel-speed sensor to ABS wiring harness and clip plug-in connection into bracket.
- \* After repairing, test using LED tester.



1 = Wheel-speed sensor,  
front axle  
2 = Mounting plate

Arrow = Wheel-speed sensor,  
rear axle left



REPAIR PROHIBITION /  
MAXIMUM ALLOWABLE STORAGE TIME  
FOR ABS HYDRAULIC MODULATORS

13....39  
VDT-I-265/102 En  
1.1986

Replaces edition of 7.1984

1. Repair prohibition

ABS for passenger vehicles is a safety system.

Unauthorized tampering with ABS components brings with it the danger of impairment of the proper functioning of the ABS system.

# For reasons of safety, therefore, the  
# hydraulic modulator may under no circum-  
# stances be repaired, but instead must be  
# exchanged as a complete unit.

Only the engine and valve relays may be exchanged.

No other screws or plugs may be loosened or removed.

2. Maximum allowable storage time

The maximum allowable storage time for hydraulic modulators is 5 years from the date of manufacture (FD) specified on the product.

This requires that the following storage conditions be fulfilled:

- Hydraulic modulator filled with brake fluid (supplied in filled condition).
- Vertical/upright position (hood on top).
- Ambient temperature between -20°C and +50°C.
- Dry storage.

After 5 years storage time, all rubber and plastic parts must be replaced and the hydraulic modulator must be subjected to a functional test.

The replacement of rubber and plastic parts and the functional test can be carried out only at the place of manufacture. After testing, the hydraulic modulators are marked with |L| and a new date of manufacture (FD).

Service workshops in the Federal Republic of Germany should send the hydraulic modulators to:

Robert Bosch GmbH Abt. K1/VAK 2,  
Robert-Bosch-Straße, 7141 Schwieberdingen.

Service workshops in other countries are requested to send the hydraulic modulators to:

Robert Bosch GmbH, KH/LAV 2 - Auspackraum,  
z.W. an K1/VAK 2, Auf der Breit 4,  
D-7500 Karlsruhe 41  
West Germany.

The hydraulic modulators should be sent to us pre-paid. Please refer to this Technical Bulletin on the enclosed delivery ticket.

A fee is charged for parts replacement and functional testing.

Responsible:

ROBERT BOSCH GMBH

Division KH

Technical After-Sales Service (KH/VKD 2)

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